DECEMBER, 1941.

GENERAL PHYSICS.

ATOMIC AND MOLECULAR STRUCTURE.

2439. On a simple derivation of the nuclear dispersion formula. T. Sexl. *Z. Phys.*, **115**, 9–10, *pp.* 571–577, 1940. *In German.*—On the basis of the 3-dimensional, static nuclear model a simple derivation of the nuclear dispersion formula is given. O. O.

***2440. The construction of a mass spectrometer for isotope analysis.** H. Brown, J. J. Mitchell and R. D. Fowler. *Rev. Sci. Instrum.*, **12**, *pp.* 435–441, *Sept.*, 1941.—The complete constructional details for a 180° Dempster type mass spectrometer are given. The ions have a radius of curvature of 15 cm. and are accelerated through a potential of 2000 V. Circuit diagrams for the voltage stabilizers and magnet current stabilizer are included. Authors.

2441. Steric hindrance. I. L. Gauditz. *Z. phys. Chem. B.*, **48**, *pp.* 228–237, *March*, 1941. *In German.*—Following up researches on the formation of supermolecules [Abstr. 2204 (1941)] the author investigates the question of steric hindrance by determining the equilibria of half acetal formation from a homologous series of alcohols and aldehydes dissolved in heptane. The influence of the molecular shape is shown. R. N.

2442. Orientation-polarization and formation of super-molecules. H. Dunken, F. Judenberg and K. L. Wolf. *Z. phys. Chem. B*, **49**, *pp.* 43–63, *May*, 1941. *In German.*—By means of the law of mass action the functional relation is calculated between orientation-polarization and concentration; 2 groups of solutions are distinguished. The one represented by ketones shows a monotonous decline of the orientation-polarization with increasing concentration. The other is represented by aliphatic acids in hydrocarbons and by alcohols in hydrocarbons or in CCl_4, CS_2. The former have a min. value and the latter min. and max. values of the curve representing the above function. This behaviour is explained by the dipole moments of the single molecules and their supermolecular associations. [See Abstr. 2204 (1941)]. R. N.

See also Abstracts 2456, 2587, 2624, 2625, 2672, 2730.

COLLOIDS.

2443. Silica aerogel as a flatting agent for protective coatings. J. F. White and I. V. Wilson. *Industr. Engng Chem.*, **33**, *pp.* 1169–1173, *Sept.*, 1941.—Data on the physical properties of silica aerogel pertinent to incorporation in protective coatings are given, as well as a brief description of the method of manufacture and the theories involved. Results obtained by effecting this incorporation by ball milling and roller milling show that the method employed influences the results considerably, and that ball milling is to be preferred because of increased stability and control of the grinds. Data are included on the transparence, plasticity, flatness and strength, of films containing silica aerogel, aluminium stearate, and stearated diatomaceous earth. Authors.

2444. Sulphur-asphalt dispersions. I. Bencowitz. *Industr. Engng Chem.*, **33**, *pp.* 1165–1168, *Sept.*, 1941.—Sulphur ground with asphalt and kerosene forms stable suspensions from which aqueous emulsions can be prepared, using a sulphonated alcohol as an emulsifying agent. Emulsions containing as little as 1·5% S or as much as 70% remained stable for more than 6 months, either standing on the shelf or with intermittent shaking. The grinding, though conducted in a specially constructed grinder, can be accomplished in any ball mill and the emulsion is formed by hand stirring. Violent stirring is not required. The viscosities of these emulsions seem to be independent of the asphalt concentration, and are determined by a function expressed by (kerosene conc.)^2 ÷ (S and H_2O conc.). The usefulness of these emulsions as insecticides and ovicides is suggested. Author.

2445. Colloidal stability of asphalts. H. F. Winterkorn and G. W. Eckert. *Industr. Engng Chem.*, **33**, *pp.* 1285–1289, *Oct.*, 1941.—Data are presented on the appearance of spots obtained with a number of different solvents and solvent mixtures, as well as results obtained with the standard Oliensis procedure. Variations in standing time, as first suggested by Oliensis, or the use of varying proportions of naphtha/asphalt or naptha/hexane, as described here, seem to make the spot test a more general method of differentiating or evaluating asphaltic materials which give negative spots by the Oliensis procedure. In the case of asphaltic materials giving positive tests, either the xylene equivalent may be used, or other liquids may be employed, whose solvent power differentiates between the relative heterogeneity of such materials, e.g. solvents such as tetrahydronaphthalene, decahydronaphthalene, and cyclohexane are useful. The positive spots obtained with furfural and aniline, and particularly with pyridine and nitrobenzene (materials of high solvent power for asphalts), indicate that, while the solvent power for the same class of solvents may vary with the surface tension of the solvent, there can be a vast difference in the reaction upon asphalt of solvents of equal surface tension but of different chemical types. H. H. Ho.

2446. X-ray and electron-microscopic investigation of the process of grinding cellulose. K. Hess, H. Kiessig and J. Gundermann. *Z. phys. Chem. B*, **49**, *pp.* 64–82, *May*, 1941. *In German.*—The investigations show that the change of the properties of cellulose during fine grinding is due not only to the relative increase in surface. Considerable changes take place inside the particles. The lattice-ordered state disappears as is shown by X-ray examination. Recrystallization takes place by treatment with water, but hydrated, not natural, cellulose is formed. Viscosity decreases due to changes inside the fundamental fibrils. With continued grinding these fibrils are crimped and filter without further breaking. R. N.

See also Abstracts 2504, 2514, 2517, 2668.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

2447. On the reflection spectrum of electron waves from a cleaved surface of NaCl. T. Yamaguti. *Proc. Phys.-Math. Soc., Japan*, **23**, *pp.* 433–439, *June*, 1941.—Reflection spectra of electron waves from a cleaved surface of NaCl and from the surface covered with condensed crystallites of the crystal were taken simultaneously on the same photographic plate with a view to obtaining accurate values for the ratio between wavelength and spacing. The apparent inner potential is deduced from the former spectra for each order reflection. Though the inner potential, evaluated from high-order reflections, has a definite value, the value derived from the first- and the second-order reflections still show remarkable deviations. An interpretation of the second-order reflection led to the conclusion that an expansion of the spacing of the surface layers is contrary to the contraction deduced theoretically by Lennard-Jones and others. Other possibilities for the explanation of the low-order reflections are discussed. Author.

2448. Electron diffraction study on the mechanism of crystallization of salts from their aqueous solutions : zinc chloride. S. Yamaguchi. *Sci. Pap. Inst. Phys. Chem. Res., Tokyo*, *No.* 1032, *pp.* 382–386, *June*, 1941.—It was previously reported that, when crystallization took place from an aqueous $ZnCl_2$ solution, a certain amorphous substance appeared in the first stage, which rapidly turned into small crystals arranged at random and then into a single crystal on being desiccated in the electron camera. This observation has now been repeated, and an explanation of the halo pattern has been derived. The mechanism of crystallization of $ZnCl_2$ from its aqueous solution is discussed. It is suggested that water hinders the ionic bond formation between Zn^{++} and Cl^-, since $ZnCl_2$ ionizes easily in water, while water plays no rôle in the homopolar bond formation. It is thus comprehended that the (100) planes in the $ZnCl_2$ crystal appear fast and then other planes are completed when $ZnCl_2$ crystallizes out of its solution. Since the lattice energy of the Zn-Cl bond is greater than that of the Zn-Zn bond, the (100) planes cannot stretch as much as the other planes. H. H. Ho.

2449. Statistical theory of binary alloys. II. Application to ferromagnetism. Y. Takagi. *Proc. Phys.-Math. Soc., Japan*, **23**, *pp.* 553–567, *July*, 1941.—Using the general free-energy formula of binary alloys discussed previously [Abstr. 1116 (1941)], the magnetic and thermal properties of the so-called Heisenberg model of ferromagnetics are now investigated in detail, and the principal results are: (1) If the number, z, of nearest neighbours $=2$, the result is in agreement with that given by Ising's vigorous treatment of the linear chain problem. Since the magnetism vanishes in zero field, this system is not ferromagnetic. (2) If $z \geq 3$, the existence of spontaneous magnetism and of the ferromagnetic Curie temperature T_f is predicted. (3) At temperatures $> T_f$ the curve of the reciprocal of the paramagnetic susceptibility is slightly convex toward the T-axis. (4) The sp. ht. anomalies, which originate from the spin configurational energy, are similar to those predicted by Bethe in his theory regarding the order-disorder transformation of binary alloys. (5) The Weiss-Heisenberg theory of ferromagnetism is deduced from these results by the same manipulation as that by which the Bragg-Williams theory (regarding the superlattice problem) was deduced from the Bethe theory. H. H. Ho.

2450. Electron diffraction and the surface structure of the acid stable alloys : ferro-silicon (duriron) in sulphuric acid. S. Yamaguchi. *Sci. Pap. Inst. Phys. Chem. Res., Tokyo*, *No.* 1035, *pp.* 409–413, *July*, 1941. *In German.*—Experiments are described in which samples of duriron (14·5% Si), whose microstructure consists of mixed crystals of Fe and Si with a small amount of Fe_3Si_2, were immersed in H_2SO_4 of various concentrations (10–30 N). The surfaces were then investigated by means of the electron diffraction method. Only SiO_2 appears to be formed on the surface of the duriron, and the action of the

H_2SO_4 is apparently a selective oxidation, the mechanism being as follows: The iron is soluble in the acid, but the silicon remains on the surface and, being activated, combines partly with oxygen and is partly recrystallized by metallic iron.

H. H. Ho.

2451. A cadmium-bismuth oxide with incomplete oxygen lattice. L. G. Sillén and B. Sillén. *Z. phys. Chem. B*, **49**, *pp.* 27–33, *May*, 1941. *In German.*—A space-centred cubic phase was established in rapidly cooled fusions of CdO and Bi_2O_3. If *x* is the ratio of Cd atoms and total metallic atoms, 1 cell of the cubic phase contains 8 Cd_{2x} Bi_{2-2x} O_{3-x}. It is stable for values of *x* between about 0·16 and 0·27. Density and X-ray measurements show that there must be empty points in the O lattice, while the metal lattice seems to be complete; 2 possible arrangements of the O atoms are discussed, 1 of them being the more probable.

R. N.

2452. Retrograde transformation of ND_4Br. II. A. Smits and P. G. Meerman. *Z. phys. Chem. B*, **49**, *pp.* 13–20, *May*, 1941. *In German.*—ND_4Br has 2 stable cubic states, one above — 58°, the other below — 114°C. Both are identical with regard to X-ray spectrographic behaviour [see Abstr. 4309 (1938)]. To decide whether a true retrograde transformation takes place the piezo-electric behaviour was investigated. No piezo-electric effect was found between room temperature and the temperature of liquid air. The 2 modifications are identical and belong to the same phase range and the same range of mixed crystals. Retrograde transformation is therefore proved.

R. N.

2453. Structure and dynamics of liquids. W. E. Roseveare, R. E. Powell and H. Eyring. *J. Appl. Phys.*, **12**, *pp.* 669–679, *Sept.*, 1941.—A liquid may be considered to be a solid to which a large number of empty equilibrium positions are added. Expansion on melting and on heating arise almost entirely from this introduction of new equlibrium positions and only to a small extent from expansion of the lattice. The partition function for a liquid based on this theory of structure is obtained. Fluidity at const. volume and at const. pressure is also considered. The mixture law for diffusion is deduced and results in good agreement with experiment are obtained, indicating that the assumption made, that the flow process involves a single molecule passing over a barrier into a hole, is correct. The orientation of flowing molecules, giving rise to optical anisotropy in pure liquids in motion, is also considered, and a formula is deduced which is in good agreement with experiment.

A. J. M.

2454. Explanation of regularities in clearing and transformation points in homologous series of liquid crystalline substances; 2nd contribution to the chemical morphology of liquids. C. Weygand and R. Gabler. *Z. phys. Chem. B*, **48**, *pp.* 148–153, *Jan.*, 1941. *In German.*—The observation that with increasing length of chain homologous series attain more and more similar properties, e.g. a fixed m.p., is shown to apply also to the clearing point of nematic and smectic substances. Of the substances investigated the former show alternating temperatures converging to about 100°C. with increasing number of chain links, while the latter approach about the same fixed temperature. The significance of this behaviour is discussed. [See Abstr. 2214 (1941)].

R. N.

See also Abstracts 2641, 2653, 2673.

DENSITY.

2455. P-V-T relations for saturated liquids. H. P. Meissner and O. H. Paddison, Jr. *Industr. Engng Chem.*, **33**, *pp.* 1189–1191, *Sept.*, 1941.—Liquid densities can be predicted with reasonable accuracy by use of the charts presented in this article, if the critical temperature, critical pressure and some v.p. data, are available.

Authors.

See also Abstract 2506.

DIFFUSION AND OSMOSIS.

2456. The separator tube. III. G. Dickel and K. Clusius. *Z. phys. Chem. B*, **48**, *pp.* 50–62, *Nov.*, 1940. *In German.*—With the method previously described [Abstr. 581 (1940)] it was possible to separate 2·5 l. of each of the pure isotopes ^{22}Ne and ^{20}Ne; 2 l. of Ne were prepared in which the rare isotope ^{21}Ne was increased from 0·27% to 2·5%. The influence of impurities is discussed, and errata in the previous paper are corrected.

R. N.

2457. The velocity of diffusion in a mixed gas; the second approximation. S. Chapman and T. G. Cowling. *Proc. Roy. Soc. A*, **179**, *pp.* 159–169, *Oct.* 10, 1941.—The general equation of diffusion in a mixed gas in non-uniform motion, in the presence of forces imparting differential accelerations to the 2 constituents, and of gradients of composition, pressure and temperature, has been carried to a second approximation. This adds 9 new terms to the expression for the velocity of diffusion, and each term involves as a factor a new second-order diffusion coefficient. All the new terms depend on the gradients of the mean motion of the gas and vanish if this is uniform. One of the new terms is proportional to the space gradient of the tensor that expresses the rate of distortion of the gas; 2 other terms include parts involving the second space differential coefficients of the mean motion. The other portions of the 2

latter terms, and the remaining 6 terms, depend on products of the velocity gradients and the factors that appear in the first-order diffusion equation, namely the gradients of composition, pressure and temperature, and the relative accelerations of the 2 types of molecule. The expressions for the 9 new diffusion coefficients are extremely complicated, and have been evaluated only approximately. The new terms in the velocity of diffusion are with one exception negligible compared with the first-order terms, at pressures above 10^{-6} atm., except possibly in shock waves where the mean velocity of the gas alters by an appreciable fraction in a distance equal to the m.f.p. The excepted term is the one which depends on the gradient of the rate-of-distortion tensor; in certain circumstances this is comparable with, though smaller than, the first-order pressure-diffusion term. It materially reduces the rate of diffusion in a stream of mixed gas flowing under pressure along a fine capillary tube.
AUTHORS.

***2458. A laboratory experiment on diffusion of gases.** A. Longacre. *Amer. J. Phys.*, **9**, *pp.* 232–233, *Aug.*, 1941.

2459. Diffusion : as a basis of unit operations. *Industr. Engng Chem.*, **33**, *pp.* 423–501, *April*, 1941.—A symposium containing the following papers:—The rôle of diffusion in engineering operations, T. K. Sherwood [Abstr. 2460 (1941)]. Diffusion, thermal conductivity, and viscous flow of liquids, R. E. Powell, W. E. Roseveare and H. Eyring [Abstr. 2511 (1941)]. Heat and vapour transfer in a wetted-wall tower, W. I. Barnet and K. A. Kobe [Abstr. 2665 (1941)]. Non-equilibrium behaviour in heterogeneous hydrocarbon systems, J. B. Hatcher and B. H. Sage [Abstr. 2477 (1941)]. Rate of solution of crystals, R. H. Wilhelm, L. H. Conklin and T. C. Sauer [Abstr. 2497 (1941)]. Prevention of fog in cooler-condensers, A. P. Colburn and A. G. Edison [Abstr. 2688 (1941)]. Simplified calculation of diffusional processes, A. P. Colburn [Abstr. 2461 (1941)]. Determination of unit conductances for heat and mass transfer by the transient method, A. L. London, H. B. Nottage and L. M. K. Boelter [Abstr. 2666 (1941)]. Continuous separation of gaseous mixtures by fractional diffusion through porous membranes, K. Kammermeyer and H. T. Ward [Abstr. 2462 (1941]. Agitation. Mass transfer coefficients in liquid-solid agitation systems, A. W. Hixson and S. J. Baum. Rate of absorption of ammonia by water in a packed tower, O. E. Dwyer and B. F. Dodge. Gas absorption in bubble-cap columns, J. F. Walter and T. K. Sherwood.

2460. The rôle of diffusion in engineering operations. T. K. Sherwood. *Industr. Engng Chem.*, **33**, *pp.* 424–429, *April*, 1941.—The basic ideas are reviewed and their inter-relations emphasized. Some examples of the application of fundamental information are presented, along with a compilation of the types of future research which seem desirable.
AUTHOR.

2461. Simplified calculation of diffusional processes. A. P. Colburn. *Industr. Engng Chem.*, **33**, *pp.* 459–467, *April*, 1941.—Simple approx. equations are derived and represented graphically for calculating the number of transfer units or theoretical plates for operations such as absorption, distillation, and counter-current liquid-liquid extraction. These equations and graphs are extended to apply where there is curvature in the operating or equilibrium line, or both.
AUTHOR.

2462. Continuous separation of gaseous mixtures by fractional diffusion through porous membranes. K. Kammermeyer and H. T. Ward. *Industr. Engng Chem.*, 33, *pp.* 474–478, *April*, 1941.—The separation of gas mixtures by diffusion through porous membranes was investigated for the systems N,CO_2 and H,CO_2. Equilibrium curves were established for composition of feed *v.* product. The theoretical interpretation involves the sum of molecular diffusion and mass motion in fluid flow. The results are compared with those of membrane diffusion with atmolysis. The literature and commercial and economic aspects are discussed.
AUTHORS.

2463. On the osmotic pressure. H. Frahm. I. *Z. phys. Chem. A*, **184**, 6, *pp.* 399–410, 1939. II. *Z. phys. Chem. B*, **48**, *pp.* 119–123, *Jan.*, 1941. *In German.*—Starting from Maxwell-Boltzmann's law of energy distribution the general law concerning relative decrease of v.p. and osmotic pressure of solutions is derived. Raoult's and van't Hoff's laws, governed by thermal energy exchange between solved and solvent molecules, are contained in this general law as boundary cases. Deviations are caused by specific molecular forces. Graphs for aqueous solutions of NaCl and C_2H_5OH serve as examples to show the dependence of osmotic energy on the molar fractions as determined according to van't Hoff's formula, the author's formula and by experiment. Raoult's law is proved by kinetic and thermodynamic considerations. The criticisms of Fredenhagen and Tramitz [Abstr. 2498 (1941)] are refuted. [See Abstr. 2687 (1941)].
R. N.

***2464. Construction of a spindle type Svensson diagonal slit.** J. W. Burns and L. K. Henke. *Rev. Sci. Instrum.*, **12**, *pp.* 401–404, *Aug.*, 1941.—The practical working part of the theory of the Svensson method for the direct photography of concentration gradients is given along with the design of a special diagonal slit for the accurate evaluation of diffusion constants, or the concentration of material present from the areas under Svensson diagrams. A. H.

ELASTICITY AND PLASTICITY.

2465. Axially symmetrical stress in a thick tube. A. M. Binnie. *Phil. Mag.*, **32,** *pp.* 336–347, *Oct.*, 1941.—The well-known analysis of the stress in a uniform tube, the wall-thickness of which is comparable to the radius, is confined to cases of plane strain. This paper explains how the stress distribution may be calculated when the restriction is removed, the tube being subjected to an axially symmetrical arrangement of forces. The method employed is an extension of that due to Filon, who examined the stresses in a cylindrical specimen held in a testing machine by various types of grip; it can be applied to a wide variety of cases of imposed stresses and displacements. The general solution is followed by a detailed analysis of the case where the plane ends are free from normal stress and the curved surfaces are subjected to a given distribution of normal and shear stresses. Finally, the stresses in a tube loaded with an external belt of uniform pressure are investigated numerically. This example incidentally provides some information concerning the validity of St. Venant's principle. Author.

2466. The circular cylinder with a band of uniform pressure on a finite length of the surface. M. V. Barton. *J. Appl. Mech.*, **8,** *A*97–*A*104, *Sept.*, 1941.—The solution to the fundamental problem of a cylinder with a uniform pressure over ½ its length and a uniform tension on the other half is found by using the Papcovitch-Neuber solution to the general equations. The results, given analytically in terms of infinite-series expressions, are exhibited as curves giving a complete picture of the stress and deformation. The case of a cylinder with a band of uniform pressure of any length is solved by the method of superposition. The stresses and displacements are evaluated for the special cases of a cylinder with a uniform pressure load of 1 dia. and ½ dia. in length. The problem of a cylinder heated over ½ its length is solved by the same means. Author.

2467. The effect of grain direction on the Young's moduli and rigidity moduli of beech and sitka spruce. R. F. S. Hearmon and W. W. Barkas. *Proc. Phys. Soc., Lond.*, **53,** *pp.* 674–680, *Nov.*, 1941.—The implications of the assumption that wood possesses rhombic symmetry are discussed, particularly in relation to the effects of grain angle on Young's modulus and rigidity modulus. Simple methods, involving the frequencies of vibration of thin strips cut at the appropriate grain angle, are described to measure these effects. The experimental results agree with the calculated values as closely as can be expected for a variable and elastically imperfect material such as wood. Authors.

2468. Classification of isotropic points as defined by $\sigma_1 - \sigma_2 = 0$ within a regular region. M. A. Sadowsky. *J. Appl. Phys.*, **12,** *pp.* 605–609, *Aug.*, 1941.—Paper presented at a photo-elasticity conference in Pittsburgh in 1940; σ_1 and σ_2 are the 2 principal stresses, and points at which $\sigma_1 - \sigma_2 = 0$ are called isotropic points. At such points the direction angle, ϕ, of a principal stress is indefinite, ϕ being discontinuous. Airy's stress function is used to compute the stresses. For an isotropic point of index zero the stress trajectories are straight lines of the form: $x = \text{const.}$, and $y = \text{const.}$ Such points have been observed in photo-elastic photographs. They are dark spots and cannot be removed by rotation of the plane of polarization. The number of stress trajectories emanating from an isotropic point may have 1 of 3 values. The isotropic points most frequently observed in experimental photo-elasticity are cited and the trajectories drawn. G. E. A.

2469. Note on the angular motions of ships. N. Minorsky. *J. Appl. Mech.*, **8,** *A*111–*A*120, *Sept.*, 1941.—The paper brings to the attention of mechanical engineers a number of dynamical problems encountered in the theory of the ship; indicates briefly the form of corresponding differential equations and their solutions; analyses the validity of underlying theoretical assumptions; and approaches in this manner a comparison of the ship's dynamics with problems commonly encountered in other fields, such as that of vibration theory. Author.

***2470. Experimental investigation of a quasi-harmonic oscillator.** H. Neusinger. *Akust. Z.*, **5,** *pp.* 11–26, *Jan.*, 1940. *In German.*—A mechanical appliance has been developed for investigating the phenomena connected with oscillating systems having periodically variable members. It consists of a pendulum with variable fulcrum and acted upon by a spring with a periodically changing force. The appliance permits of solving experimentally Mathieu's differential equations with real positive parameters. Stability relations and the form of pendulum oscillations are investigated, and good agreement is found between experimental and calculated results. R. N.

2471. Wave action in gun run-up springs. H. G. W. Taylor. *Proc. Instn Mech. Engrs, Lond.*, **145,** *pp.* 150–159, *Sept.*, 1941.—A mathematical study is made of the movement of a column of identical springs used in a gun recuperator system. The recuperator gear of a 4 in. 50-calibre naval gun consisted of 4 identical springs, and it was found that fracture often occurred at the centre of the third spring. The theory is applied to this arrangement as an example of the method, and, when the max. velocity of recoil is taken as a function of time, the recoil impulse travels along the springs and produces relative movement of the coils. Conditions can arise in which the movement produced by this wave will cause the coils to crash into each other. Methods were also devised of recording the movement of such a set of coils together with measurements of the thrust between the springs and the mounting. A falling weight was used to give the recoil velocity, but an actual gun was employed in the thrust-measuring experiments. Heavy felt washers placed at the rear of the run-up springs reduced the violence of the thrust, but the effect disappeared after a number of rounds had been fired. When the springs were arranged to buckle under compression, the frictional forces damped out the violence of the blow carried by the initial wave, and a similar effect was obtained by using a stouter spring (at the rear of a column of 8). A. C. W.

See also Abstract 2671.

GRAVITATION.

2472. On the law of universal repulsion. T. Takeuti. *Proc. Phys.-Math. Soc., Japan*, **23**, *pp*. 432–433, *June*, 1941.

HYDRODYNAMICS AND AERODYNAMICS

2473. Temperature effects in a laminar compressible-fluid boundary layer along a flat plate. H. W. Emmons and J. G. Brainerd. *J. Appl. Mech.*, **8**, *A*105–*A*110, *Sept.*, 1941.—The 2-dimensional boundary-layer problem of the steady laminar flow of a perfect gas along a thin flat insulated plate has been solved for a wide range of gas velocities and properties. It is found that compressibility and Prandtl number do not introduce any new phenomena, but do alter the drag on the plate, the equilibrium temperature of the plate, and the velocity and temperature distribution through the boundary layer. Authors.

***2474. A wind tunnel for student experiments and for demonstrations.** I. F. Zartman and W. Eberly. *Amer. J. Phys.*, **9**, *pp*. 84–87, *April*, 1941.

2475. The shape of a liquid jet. J. M. A. Lenihan. *Phil. Mag.*, **32**, *pp*. 393–400, *Nov.*, 1941.—A jet of liquid falling at low speed on to a smooth surface assumes a corrugated or beaded shape, hitherto regarded as a stationary wave pattern, caused by progressive disturbances travelling over the surface with the same speed as the falling liquid. An alternative explanation, based on a graphical solution to Bernoulli's equation, is put forward, and is in agreement with observation. Author.

2476. Discharge coefficients of long-radius flow nozzles when used with pipe-wall pressure taps. H. S. Bean, S. R. Beitler and R. E. Sprenkle. *Trans. Amer. Soc. Mech. Engrs*, **63**, *pp*. 439–445, *July*, 1941.—In continuation of previous work [*Trans. Amer. Soc. Mech. Engrs*, **60**, *pp*. 235–244, 1938] the authors discuss the results of their separate analyses of results, obtained in the laboratories of 41 co-operating companies, relating to the discharge coeffs. of long-radius or elliptical type of flow nozzles when used with pressure taps connected to the pipe wall with the inlet-pressure tap located 1 pipe dia. ahead of the nozzle-inlet face, and the outlet-pressure tap about ½ pipe dia. following the nozzle-inlet face but in no case beyond the outlet end of the nozzle. The results are discussed, mainly in terms of the relation between the discharge coeff. and the Reynolds number, and refer to flow nozzles in 2, 3, 4, 6, 8 and 10 in. pipes. It is suggested that, for nozzles in pipes larger than 10 in., the coeff. curves for a 10 in. pipe can be employed. J. S. G. T.

2477. Non-equilibrium behaviour in heterogeneous hydrocarbon systems. J. B. Hatcher and B. H. Sage. *Industr. Engng Chem.*, **33**, *pp*. 443–452, *April*, 1941.—A thermodynamic criterion for the existence of bubbles in supersaturated liquids is discussed. Diffusion constants for *n*-butane in a hydrocarbon liquid were determined experimentally as a function of composition at 100°F. The influence of natural and forced convection upon the transfer of *n*-butane to and from hydrocarbon liquids was investigated. The usual concept of an effective film thickness was found to be a useful means of comparing experimental results of this nature. Experimental work indicated that turbulence was of nearly controlling importance in determining the degree of supersaturation obtainable in hydrocarbon liquids. The results are presented in graphical form. Authors.

See also Abstract 2453.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

2478. On the numerical solution of linear simultaneous equations by an iterative method. R. J. Schmidt. *Phil. Mag.*, **32**, *pp*. 369–383, *Nov.*, 1941.

2479. Method of finding the equations of curves. J. C. Barnes. *Engineering*, **152**, *p*. 334, *Oct*. 24, 1941.—Tabulate Cartesian ordinates y for abscissae in x of 0, 1, 2, 3 . . . etc. Take differences D_1, second differences D_2, etc., up to D_r, the last being constant. Then the equation to the curve is $y=C_r x^r+C_{(r-1)}x^{r-1}+\ldots+C_1 x+C_0$. The coefficients C_r, etc., are given by: $C_r=D_r/r!$; $C_{(r-1)}=\{{}_1D_{(r-1)}-{}_rK_rC_r\}/(r-1)!$; $C_{r-2}=\{{}_1D_{(r-2)}-{}_{(r-1)}K_r$.

$C_r - {}_{r-1}K_{(r-1)}C_{(r-1)}\}/(r-2)!$; etc., where ${}_1D_r$ is the first term in the rth difference column, ${}_1D_{(r-1)}$ the first term in the $(r-1)$th difference column, etc. The constants K_r are given by: ${}_1K_r=(0)^r$; ${}_2K_r=(1)^r-(0)^r$; ${}_3K_r=(2)^r-2(1)^r+(0)^r$; ${}_4K_r=(3)^r-3(2)^r+3(1)^r-(0)^r$; ${}_5K_r=(4)^r-4(3)^r+6(2)^r-4(1)^r+(0)^r$; etc. G. F. F.

2480. On a certain variation of the distributive law for a commutative algebraic field. A. Robinsohn. *Proc. Roy. Soc. Edinb.*, **61**, 1, *pp.* 93–101, 1941.

2481. On algebraic Lamé functions. A. Erdélyi. *Phil. Mag.*, **32,** *pp.* 348–350, *Oct.*, 1941.

2482. Note on Heine's integral representation of associated Legendre functions. A. Erdélyi. *Phil. Mag.*, **32,** *pp.* 351–352, *Oct.*, 1941.

2483. On the measurable stochastic process. Y. Kawada. *Proc. Phys.-Math. Soc., Japan*, **23,** *pp.* 512–527, *July*, 1941.

2484. Whole-number properties of time and space. IV. A. March. *Z. Phys.*, **115,** 9–10, *pp.* 522–529, 1940. *In German*—The "1_0- Metrik" requires deviations from the present theory. They are expressed by the following relation for the change of momentum Δp and the change of energy ΔE of a particle.

$$|\Delta p|^2 - c^{-2}|\Delta E|^2 < (h/2l_0)^2$$

This relation is applied to various processes and the results compared with experiments. O. O.

See also Abstract 2470.

MECHANICS. CLASSICAL.

2485. Action of deep beams under combined vertical, lateral, and torsional loads. C. O. Dohrenwend. *J. Appl. Mech.*, **8,** *A*130–*A*134, *Sept.*, 1941.

2486. Experimental examples in dynamics. C. A. Ludeke. *Amer. J. Phys.*, **9,** *pp.* 162–166, *June*, 1941.

2487. Rate of energy loss from rebounding steel balls. R. Schnurmann. *Proc. Phys. Soc., Lond.*, **53,** *pp.* 662–670; *Disc.*, 670–673, *Nov.*, 1941.—The total bouncing time of hardened steel balls released from given heights above the practically plane surfaces of hardened steel anvils of limited size has been measured at room temperature. The coefficient of restitution is very little different from unity in the sensibly elastic region of deformation in which the heights of fall of the sphere plotted against the corresponding total bouncing times lie on a parabola. The multiple rebounds sufficiently integrate the small energy loss for the well reproducible total bouncing time to vary measurably when the coefficient of restitution is altered by an exceedingly small amount. For a given material and initial height of fall the smaller sphere exhibits the longer bouncing time. Defective spheres show striking deviations from this rule. The total bouncing time increases with the height of the anvil until this has reached a certain value. Lunette-shaped markings have been observed on the highly polished surface of the anvils as the result of a great number of rebounds. Author.

2488. The production of high rotational speed. L. E. MacHattie. *Rev. Sci. Instrum.*, **12,** *pp.* 429–435, *Sept.*, 1941.—Small steel rotors have been suspended by an axial magnetic suspension using inductance control to effect vertical stabilization. They have been spun in vacuum by means of a rotating magnetic field having a frequency of the order of 100 kc./s. Rod rotors tended to precess in the absence of horizontal damping. This was remedied by placing a copper block just above the upper end of the rod. A tapered length of drill rod $\frac{7}{8}$ in. long (max. dia. $\frac{3}{16}$ in.) reached 36000 r.p.s. before bending double due to the effect of centrifugal force. Steel balls have the advantage of no precession; however, on starting to spin they soon built up a circular orbital motion of increasing amplitude. A damping needle situated outside the vacuum system and immersed in oil was found to eliminate this motion satisfactorily. A $\frac{3}{32}$ dia. ball has been spun to 110 000 r.p.s. This corresponds to a centripetal acceleration at the periphery of 58×10^6 gravity. The rate of free deceleration at 106 000 r.p.s. was about 1% per hr. Rotational speed was measured by observing the rotor in stroboscopic light whose frequency could be matched with the speed of the rotor. Author.

2489. Systems of coupled rotators. G. Eichhorn. *Z. Phys.*, **115,** 9–10, *pp.* 578–591, 1940. *In German.*—Chains or networks of rotators which are coupled by their dipole moments are treated by a statistical-mechanical method. For chains up to 4 rotators the energy and sp. ht. are computed as functions of the temperature. The sp. ht. has a max. which becomes higher and sharper with increasing number of rotators. O. O.

See also Abstract 2511.

MECHANICS, QUANTUM.

2490. Further studies on solving eigenvalue problems by factorization. E. Schrödinger. *Proc. Roy. Irish Acad. A*, **46,** *pp.* 183–206, *May*, 1941.—The operator to be factorized is $Q=p(d^2/dx^2)+q$ where p, q are functions of x. The most general linear operator is $\sigma^{-1}v^{-1}(d/dx)\sigma w$, where v,w are functions of x and $\sigma(x)$ is a positive density function. The conditions which must be satisfied by v, w so that the product of the linear operator and its adjoint shall be identical with Q are given. Reversing the order of multiplication of linear operator and adjoint provides a second factorization of Q. The method is applied to finding the radial eigenfunctions of a system of *s* identical oscillators. As an example of irrational eigenvalues the solution for the vibrations of a string fixed at one end, whose other end is tied to the rest position by a force=const. × elongation, is worked out. The method can also be applied to pairs of first-order equations. Perturbation problems may be dealt with by adding small terms to the factors used to solve the unperturbed system. G. C. McV.

2491. Thermodynamic functions for 2-dimensional quantum statistics. B. N. Singh. *Indian J. Phys.*, **15,** *pp.* 73–78, *Feb.*, 1941.—The thermodynamic functions for an *n*-dimensional space for a gaseous assembly obeying Fermi-Dirac or Bose-Einstein statistics have been evaluated, and the values of these functions for a 2-dimensional space have been deduced as a special case. A. J. M.

RELATIVITY AND ETHER.

2492. Epistemology and modern physics. H. Jeffreys. *Phil. Mag.*, **32,** *pp.* 177–205, *Sept.* 1941.—The paper is concerned with a critical discussion of Eddington's ideas regarding the epistemological and *a priori* character of fundamental physical laws. The confusion involved in the method of dimensions, where arguments based on descriptions of the same system in different units are applied to different systems referred to the same units, is pointed out. A similar confusion occurs in Eddington's treatment of general relativity where, although special units are in fact used, they are never expressly stated. The author argues that Eddington assumes a basis for general relativity which is not purely epistemological, through this use of a special co-ordinate system. Again, in quantum theory, the argument that Eddington's *E*-number analysis arises from the existence of 2 particles is fallacious. For the analysis introduces many more pure numbers than the 4 numbers specifying the relations of 2 particles. No epistemological argument for the existence of 4-dimensional space-time therefore arises. Eddington's calculation of $hc/2\pi e^2 = 137$, on the basis of the equivalence of the exclusion principle and the Coulomb force, cannot be correct as he states it. For Eddington starts from the indistinguishability of proton and electron and yet assigns different probabilities to each. The author points out that the relative orientation of the 2 particles is probably introduced into Eddington's theory as a function periodic in time and disguised as a permutation co-ordinate. The idempotent operator in quantum theory is discussed and the legitimacy of introducing unobservables into physics is emphasized. G. C. McV.

2493. Applications of quaternions to restricted relativity and classical radiation theory. P. Weiss. *Proc. Roy. Irish Acad. A*, **46,** *pp.* 129–168, *July*, 1941.—The author defines the retarded distance, from an observer to a point on the light cone with vertex at himself, as the radius of the sphere, centred at himself, on which the point appears to lie. The problem is to express the ordinary co-ordinates of special relativity in terms of this retarded distance, the observer's proper time, and 2 suitably chosen angular co-ordinates. To solve this problem, quaternions over the field of complex numbers are introduced, with units which obey the commutation rules of Pauli spin matrices. The proof depends essentially on the expression of the 4-vector velocity of the observer as the product of a quaternion of this kind into its corresponding imaginary quaternion. The methods developed are also applied to finding a simple expression for the retarded electromagnetic field of a moving point charge and to a new derivation of the classical radiation formula. G. C. McV.

2494. Relativity, the Fitzgerald-Lorentz contraction, and quantum theory. W. F. G. Swann. *Rev. Mod. Phys.*, **13,** *pp.* 197–202, *July*, 1941.—The paper reviews former contentions of the writer to the effect that in the realm of classical physics, at any rate, the Michelson-Morley experiment has an illusory significance in relation to the theory of restricted relativity, and that in this realm there would be sense to the useful part of the theory involving, as it does, the invariance of the equations under the Lorentzian transformation, even though the Michelson-Morley experiment should give a positive effect and rods and clocks should fail to partake of the Lorentzian contraction and time changes when set in motion with velocity *v* in the system *S*. It is shown, however, that the existence of a relativistically invariant quantum theory provides for the Lorentzian contraction and allied phenomena cited above and calls for them as necessities. Without such a theory, the invariance of the equations alone would have nothing to say on these matters. Author.

2495. Non-linear equations of the electromagnetic field. R. E. Street. *Proc. Nat. Acad. Sci., Wash.*, **27,** *pp.* 413–417, *Aug.*, 1941.—A formal unified field theory is constructed by assuming that in a space with Riemannian metric there is a field specified by a tensor f_{kl} of the form $f_{kl} = \delta\phi_k/\delta x_l - \delta\phi_l/\delta x_k + q_{kl}$ where the q_{kl} can be expanded in powers of the f_{kl} beginning with terms of the second degree. Field equations are set up by the method of variation of integrals. G. C. McV.

SOLUTION.

2496. The solubility relationships of salts. F. J. Garrick. *Phil. Mag.*, **32,** *pp.* 353–364, *Nov.*, 1941.—Consideration of the ways in which the hydration energies of ions and the lattice energies of salts are affected by variation of the ionic charges and radii leads to the deduction of a number of generalizations about the relative solubilities of salts, and these are compared with observation. AUTHOR.

2497. Rate of solution of crystals. R. H. WILHELM, L. H. CONKLIN AND T. C. SAUER. *Industr. Engng Chem.*, **33**, *pp.* 453–457, *April*, 1941.—As a background for solution-agitation studies, an integration without limiting restrictions is presented for the diffusion-rate equation involved when particles of NaCl are freely suspended and dissolved in water. The integral is solved graphically and is presented as a family of curves involving 3 dimensionless variables. The following individual variables are taken into account: volume of water, amount of salt, size and shape of salt particles, concentration of solution, and increase in volume of solution as dissolution of solid salt proceeds. Experimental evidence is presented to show that the derivation is valid over the entire concentration range of NaCl solutions. An effective diffusion film thickness of 0·016 mm. is calculated for specific agitation conditions. AUTHORS.

2498. Construction of a theory of solutions. III. K. FREDENHAGEN AND E. TRAMITZ. *Z. phys. Chem. B*, **46**, *pp.* 313–378, *Aug.*, 1940. *In German.*—The v.p. curves of binary systems are discussed in their relation to changes in volume and heat of mixing. For a number of organic and inorganic binary systems it is shown that the trend of the v.p. curves is dependent either on mutual dilution, or on the formation of chemical compounds from the constituents, or on changes of the intermolecular forces. Frequently all 3 causes act in combination, but the examples are so chosen that, with some of them, one or the other of the causes is particularly effective. With regard to objections raised against the theory previously expounded [Abstr. 3901 (1939)] the authors treat the principles at some length. Discussing Planck's conceptions it is shown that the rules derived thermodynamically apply to gaseous as well as to liquid and solid solutions. The calculations are simplified by the assumption of constant external pressure. R. N.

2499. On the didactic treatment of the laws governing ideal diluted solutions. C. WAGNER. *Z. phys. Chem. B*, **46**, *pp.* 379–386, *Aug.*, 1940. *In German.*—Raoult's law concerning the lowering of the v.p. of a solution, and van't Hoff's formula for the osmotic pressure of diluted solutions, may be derived thermodynamically from Henry's law of distribution, if the latter is restricted to cases where the size of molecules in the solution equals that in the gaseous phase. The treatment proposed allows of showing the law of mass action to be kinetically plausible and derivable from the equation for ideal gases. R. N.

See also Abstracts 2518, 2519, 2679, 2680.

SURFACE PROPERTIES.

2500. Surface area and properties of carbon black. W. R. SMITH, F. S. THORNHILL AND R. I. BRAY. *Industr. Engng Chem.*, **33**, *pp.* 1303–1307, *Oct.*, 1941.—The surface areas of a number of commercial carbon blacks have been determined by the low-temperature adsorption isotherm technique. Thermal decomposition and other non-impingement type blacks possess areas of 15 to 64 m.^{2}/g. Channel blacks commonly employed as reinforcing agents in rubber have areas around 100 m.^{2}/g. Ink and colour blacks range from 100 to nearly 1 000 m.^{2}/g. The colour values of these carbons increase with surface area. The relation of iodine and diphenylguanidine adsorption to surface area has also been studied. Iodine adsorption is a direct function of surface area and, with the exception of certain high-volatile blacks, may be used as a direct measure of total surface. The adsorption of diphenylguanidine depends much more strongly on the volatile content of the black rather than its total surface. While rubber reinforcement depends in a general manner on surface area, certain blacks of nearly identical surface vary widely in the properties they impart to compounded rubber. That the state of the surface is probably of equal importance is indicated by the fact that the activity of the surface, as judged by relative ease of oxidation, may vary widely in blacks of equal area. AUTHORS.

2501. Measurements on van der Waals' adsorption of gases on glass plates. A. VAN ITTERBEEK AND W. VEREYCKER. *Z. phys. Chem. B*, **48**, *pp.* 131–147, *Jan.*, 1941. *In German.*—The measurements carried out with N_2, A, CO, CH_4, O, H_2O and D_2O, partly in the temperature range of liquid O, partly with temperatures up to 350°C., furnish an experimental proof for the theory of Brunauer, Emmett and Teller [Abstr. 1479 (1938)] except for the case of O where Zeise's theory [Abstr. 319 (1929)] was confirmed. The experimental method was previously described [Abstr. 3792 (1937)]. With vapours of H_2O and D_2O no absorption took place with temperatures higher than 180°C. R. N.

2502. Primary sorption of water by cotton. S. M. NEALE AND W. A. STRINGFELLOW. *Trans. Faraday Soc.*, **37**, *pp.* 525–532, *Oct.*, 1941.—Available data for the middle pressure ranges are supplemented by experiments and data covering sorptions from 0·1 to 1·5 mg. per g. Measurements, corrected for sorption of water by the glass, are given for the equilibrium pressures at 10 deg. intervals from 20° to 80°. Log p plotted against $1/T$ gives straight lines whose slopes show that the differential heat of sorption is 15·7 k. cal./g. mole, and is constant over the range investigated. Mechanism is briefly discussed. N. M. B.

2503. Adsorption isotherms of synthetic resin ion-exchange adsorbents. R. J. Myers, J. W. Eastes and D. Urquhart. *Industr. Engng Chem.*, **33**, *pp.* 1270–1275, *Oct.*, 1941.—Synthetic resin cation and anion exchangers exhibit typical Freundlich adsorption isotherms when placed in contact with solutions of acids and salts. The adsorption which occurs in exchange columns may be considered as a species of chromatographic adsorption, and the break-through capacity may be calculated from the adsorption isotherm. Synthetic resins show preferential adsorption phenomena, accompanied in some cases by visible chromatographic banding. H. H. Ho.

2504. Foam formation and foam stability: effect of the adsorbed layer. K. G. A. Pankhurst. *Trans. Faraday Soc.*, **37**, *pp.* 496–505, *Oct.*, 1941.—A comparison of the main methods (shaking tube, foam number, observations on single bubbles, and porous septum) of studying foam formation and stability, and a modification of the last named method, are given. Solutions of saponins, alkyl Na sulphates, Na oleate, commercial wetting agents, and gelatins, were studied by this method. Results indicate that with most substances there is an optimum foam concentration which in some cases occurs where surface tension is changing rapidly with concentration; it is not low surface tension alone that ensures stability, but the nature of the adsorbed layer giving rise to the lowering of surface tension; for the formation of a stable foam some cohesion of the adsorbed layer is necessary; with saponins and gelatins foaming properties and surface tension may vary within wide limits; small amounts of capillary active impurities can profoundly modify the foaming properties of gelatin solutions, particularly with respect to pH, thus ovalbumen appears to be preferentially adsorbed at the surface of solutions of gelatin to the almost complete exclusion of the latter. N. M. B.

***2505. A whirling arm for producing small differences of pressure, its calibration by aid of a smoke manometer and its application to measurements of surface tension.** G. F. C. Searle. *Proc. Phys. Soc., Lond.*, **53**, *pp.* 681–694, *Nov.*, 1941.—A static-head tube S, as used on aeroplanes, has a closed rounded nose A. If it move, nose forward, in non-viscous air, which is otherwise undisturbed, the pressure at a point C on S, well back from A, equals that at any point in the atmosphere at a distance from C and at the same level. Such a tube, with a small hole at C, is fixed to an arm carried by an electrically driven gramophone table, running synchronously with the 50 c./s. of the "grid" current. A central liquid joint, with which S communicates, allows connection to be made through S with C. The pressure at a point on the axis of the table is less by Δ_w than that of the atmosphere at the same level and, ideally, $\Delta_w = \frac{1}{2}\rho v^2$, where ρ is density of air and v is velocity of C in its path. The defect Δ_w is tapped off and draws inwards a soap film formed on a circular opening in a bubble cup. The radius r of bubble is found optically. On account of the viscosity of air, which is significant at slow speeds, and of other deviations from the ideal, the value of Δ_w found with the simple static-head tube, as used in the experiments, does not quite equal $\frac{1}{2}\rho v^2$. A collar on S in front of C serves as a corrector. A pressure defect Δ_b was produced by a heated buoyancy tube. By adjusting the effective height of this tube, Δ_b was balanced against Δ_w, as given by a corrected static-head tube on the whirling arm. By a smoke manometer, differences between Δ_b and Δ_w of less than 0·1 dyne cm.$^{-2}$ could be detected. In 6 comparisons of Δ_w with Δ_b, in which Δ_w ranged from 10·76 to 25·51 dyne cm.$^{-2}$, the ratio Δ_w/Δ_b, where Δ_w, Δ_b are the calculated values, lay between 0·99106 and 1·00749, with 1·00176 as a mean. Six values of the surface tension of soap solution given by $T = \frac{1}{2}r\Delta_w$, with $r = 4{\cdot}318$ to $r = 10{\cdot}596$ cm., lay between 26·69 and 27·07 and gave $T = 26{\cdot}898 \pm 0{\cdot}045$ dyne cm.$^{-1}$. Author.

2506. Densities and surface tensions of *cis*- and *trans*-decahydronaphthalene between − 30° and 180°. W. F. Seyer and C. H. Davenport. *J. Amer. Chem. Soc.*, **63**, *pp.* 2425–2427, *Sept.*, 1941.—The density/temperature relations are nearly linear, but the others deviate somewhat from linearity. Authors.

2507. Wood-water relationships. VI. The influence of ray cells on the shrinkage of wood. W. W. Barkas. *Trans. Faraday Soc.*, **37**, *pp.* 535–547, *Oct.*, 1941. [See Abstr. 2540 (1940)]. —In most woods the shrinkage under drying is greatest in the tangential direction, less in the radial direction and very small longitudinally. The small longitudinal shrinkage is due to the polar properties of the cellulose fibrils lying roughly parallel to the length of the tree. The asymmetry across the grain may be accounted for by the presence of ray cells which will partially inhibit the free shrinkage of the wood in the radial direction. The paper examines this explanation quantitatively and shows that in spruce the 3 directional shrinkages may be predicted with considerable accuracy if suitable values of the elastic constants are chosen for the fibres and ray cells and if the swelling pressure of the wood is used to determine the magnitude of the forces involved. Author.

2508. Liquid-film formation. T. H. Hazlehurst and H. A. Neville. *Industr. Engng Chem.*, **33,** *pp.* 1084–1086, *Aug.*, 1941.—The balanced-layer theory of film formation, widely quoted as an explanation of the stability of liquid films and foams, is criticized as thermodynamically unsound. It is shown that the principal experimental evidence offered to support this theory is unreliable and that the interpretation of some of the data was based on an incorrect premise, namely that pure liquids do not form films. While the authors do not propose a substitute theory in this paper, they do suggest the possibility of devising a satisfactory theory based on surface structure and cybotaxis at liquid/air interfaces. H. H. Ho.

2509. Formation of a gas layer on a silver surface. A. G. Emslie. *Phys. Rev.*, **60,** *pp.* 458–460, *Sept.* 15, 1941.—The results of Farnsworth and Winch [Abstr. 1086 (1941)] on the change with time of the photo-electric work function of a freshly deposited silver surface are interpreted in terms of the adsorption of a gas layer. The small overall change in the work function and the slow rate at which it approaches its final value lead to the conclusion that the adsorbed particles form a mobile molecular film. The variation in the adsorption rate, deduced from the experimental data, agrees with Langmuir's theory of odd and even phases of the adsorbed particles. The theory permits an estimate to be made of the surface mobility of the molecules, the result being that the average time spent by a molecule before moving to an adjacent adsorption site is about 30 min. Comparison of the initial adsorption rate with the rate of arrival of the molecules at the surface indicates that a large fraction of the incident molecules is reflected. Author.

2510. Film continuity of synthetic resin coatings. G. H. Young, G. W. Gerhardt, W. K. Schneider and G. W. Seagren. *Industr. Engng Chem.*, **33,** *pp.* 550–553, *April*, 1941.—Resistance to film breakdown by impressed voltage potentials appears to vary directly with the film thickness above the threshold thickness for complete continuity, and is a characteristic of both thermoplastic and thermo-setting resin films. Data are presented to show the utility of impressed voltage tests for determining the effects of added materials and of special treatments on resin films. Authors.

See also Abstracts 2450, 2477, 2611.

VISCOSITY AND FRICTION.

2511. Diffusion, thermal conductivity and viscous flow of liquids. R. E. Powell, W. E. Roseveare and H. Eyring. *Industr. Engng Chem.*, **33,** *pp.* 430–435, *April*, 1941.—A general theory of viscosity and diffusion is developed in terms of the statistical mechanical theory of reaction rate. Quantitative expressions are obtained which express these processes in terms of measurable thermodynamic properties of liquids. Variations in the theory, when molecules of different sizes are interdiffusing, are treated. Equations for thermal conductivity and ionic conductance are likewise developed. Authors.

2512. Viscosity of ethylene and of carbon dioxide under pressure. E. W. Comings and R. S. Egly. *Industr. Engng Chem.*, **33,** *pp.* 1224–1229, *Oct.*, 1941.—The viscosity of ethylene vapour was measured at 40°C. and at pressures from 4·40 to 137·1 atm. abs. The vapour was forced through a glass capillary by the wt. of a pellet of Hg and the time of fall of the pellet determined. The viscometer was calibrated, independent of the results on any other gas, but the calibration was checked by measurements on CO_2 vapour. The values reported are averages of measurements made with several sizes of pellet. The max. probable error is 2% below and 4% above 89 atm. The viscosities of these gases may be used in the design of equipment for h.p. processes. Authors.

2513. Note on the determination of the viscosity of shale from the measurement of wavelet breadth. N. Ricker. *Geophysics*, **6,** *pp.* 254–258, *July*, 1941.—From the breadth of a wavelet for a given travel time it is possible to calculate the viscosity of the formation through which the seismic disturbance has passed. This calculation has been carried out for the cretaceous shale of eastern Colorado, and the value thus found ranges from $2{\cdot}7 \times 10^7$ to $4{\cdot}9 \times 10^7$, with a mean value of $3{\cdot}8 \times 10^7$g./cm./sec. Author.

2514. Rôle of velocity gradient in determining the cuprammonium fluidity of cellulose. C. M. Conrad. *Industr. Engng Chem.* (*Analytical Edition*), **13,** *pp.* 526–533, *Aug.* 15, 1941.—In attempting to apply certain routine methods for determining the fluidity of raw cotton cellulose, as a measure of its textile quality, serious difficulties were encountered due to the anomalous behaviour of the solutions which was much more pronounced in the case of native cotton cellulose than in many "finished" cottons, rayons, and other cellulose derivatives. In a study of methods of expressing the results of moderately to highly anomalous solutions, such as 0·5% cuprammonium solutions of undeteriorated cotton cellulose, the velocity gradient at which the measurement is made was found to be an important factor. The results of the present study, however, do not suggest any practical means for overcoming or avoiding the anomalous effect, but the most promising procedure consists in obtaining fluidity or viscosity readings at several velocity gradients and then interpolating the results logarithmically to some common mean velocity gradient. Methods for varying the mean velocity gradient are suggested, and a mean gradient of 500 sec.$^{-1}$ is recommended as convenient for ordinary capillary viscometers. Methods are suggested for relating a unique value (i.e. a common mean velocity gradient) for any given substance to the mol. wt. H. H. Ho.

2515. Theory of internal friction introduced by cold working. C. Zener. *Phys. Rev.*, **60**, *pp.* 455–457, *Sept.* 15, 1941.—Experiments indicate that those changes in a cold worked metal which give rise to internal friction are distinct from those changes which give rise to hardening and to the broadening of X-ray lines. It is suggested that this internal friction is due to the inability of certain areas on slip planes to maintain shearing stresses. The theoretical consequences of this suggestion are carried out and are found to be in agreement with present experimental data. Author.

2516. Viscosity/molecular-weight of rubber. A. R. Kemp and H. Peters. *Industr. Engng Chem.*, **33**, *pp.* 1263–1269, *Oct.*, 1941.—The Staudinger viscosity/mol. wt. relation is critically examined. The following equation is recommended: $M = \log \eta_r \times K_{em}/C$, based on the Arrhenius relation $\log \eta_r/C = K_c$, which holds true within narrow limits, provided the viscosity range is not too great. Using both benzene and cyclohexane in the cryoscopic measurements, the const. K_{em} has been determined on fractions of depolymerized rubber, the avarage mol. wts. of which vary from about 1 200 to 8 000. Solutions of fractions with mol. wts. in excess of 1 400 have shown increased deviation from Raoult's law as their mol. wt. increased, whereas the lower polymers behave ideally. A K_{em} value of $0{\cdot}75 \times 10^4$ was found. The effect of various solvents on the viscosity of polyprene sols has been investigated, and it has been found that benzene, toluene and chloroform, are the best for general use. Authors.

2517. The internal phase and the emulsifier as factors determining the viscosity of oil-in-water emulsions. B. A. Toms. *J. Chem. Soc.*, *pp.* 542–547, *Sept.*, 1941.—An investigation of the influences of the internal phase and the emulsifier upon the viscosity of an emulsion. Series of oil-in-water emulsions (all identical with one another as regards phase-ratio, external phase, type and concentration of emulsifier) were prepared with a variety of organic liquids as internal phases and a number of univalent soaps as stabilizers. The viscosities of the emulsions were measured at 20°, and from the results obtained the active volume of the internal phase in each was calculated by means of Hatschek's formula: $\phi = (\eta' - \eta_o)^3/\eta'^3$. An explanation attributing the observed variations in viscosity to interactions between oil, soap and water, is advanced. The introduction of a numerical correction factor in the Hatschek equation is suggested. Author.

2518. Theoretical contribution to the paper of Chacravarti and Prasad on the viscosity of aqueous solutions of the mixtures $NaCl$–$MgCl_2$ and $NaCl$–$BaCl_2$. E. Asmus. *Z. phys. Chem. B*, **47**, *pp.* 357–364, *Nov.*, 1940. *In German.*—[See Abstr. 653, 1432 (1940).] The author calculates the viscosities according to the theory of Onsager-Fuoss. For $NaCl$-$MgCl_2$ good agreement exists throughout between calculated and measured values, for $NaCl$-$BaCl_2$ only for mixtures with more than 50% NaCl. [See Abstr. 2519 (1941)]. R. N.

2519. Viscosity of mixed solutions of strong electrolytes, one component having a constant concentration. E. Asmus. *Z. phys. Chem. B*, **47**, *pp.* 365–385, *Nov.*, 1940. *In German.*—[See Abstr. 2518 (1941)]. It is shown that the viscosity/concentration function [Abstr. 1432 (1940)] for aqueous mixed solutions of which one component has a constant concentration is applicable only within a limited range of concentration and only as a first approximation. The influence of electrolytic impurities in the solvent on the measured values of viscosity is discussed. R. N.

See also Abstract 2444.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

2520. Compass directions in the telescope. H. B. Brydon. *J. Roy. Astr. Soc. Can.*, **35**, *pp.* 286–288, *Sept.*, 1941.

***2521. Two useful telescope accessories.** H. B. Brydon. *J. Roy. Astr. Soc. Can.*, **35**, *pp.* 307–311, *Sept.*, 1941.—A cheap camera is described for attachment to a telescope tube for solar photography. The main constituents are a tube of reinforced corrugated cardboard, wooden flanges made from old cigar boxes, and a box-camera shutter. A similar attachment for a viewing screen is also described. A. Hu.

COMETS AND METEORS.

2522. The spectrum of Comet Cunningham, 1940c. P. Swings, C. T. Elvey and H. W. Babcock. *Astrophys. J.*, **94**, *pp*. 320–343, *Sept*., 1941.—Slit spectrograms of Comet Cunningham secured at the McDonald Observatory reveal well-resolved ultra-violet bands due to OH and NH; only the lines of low rotational quantum number are observed, as in the case of CH. The abundances of OH and NH molecules seem to be of the same order as that of CN. Each branch of the violet bands of CN has two max., one corresponding to a rotational distribution for $T \simeq 400$°K. and one corresponding to $T \simeq 50$°K. The tail bands of CN are absent. The authors discuss the variation with heliocentric distance of the relative intensities of the vibrational transitions. The rotational intensity distribution and the extension of the different bands in the head have been investigated. The cometary bands of CH belonging to the 2 electronic transitions, $A^2\Delta \rightarrow x^2\Pi$ (near λ 4 300) and $B^2\Sigma x^2\Pi$ near λ 3 900), are described. The bands observed between λ 4 000 and λ 4 130 are discussed but remain unidentified. Authors.

See also Abstract 2549.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

2523. A simple discussion of Kepler's laws. R. H. Bacon. *Amer. J. Phys.*, **9**, *pp*. 221–224, *Aug*., 1941.

STARS.

2524. The dynamics of the interstellar medium. II. Radiation pressure. L. Spitzer, Jr. *Astrophys. J.*, **94**, *pp*. 232–244, *Sept*., 1941.—[See Abstr. 1477 (1941)]. Radiation pressure will repel dust particles from a late-type star of high luminosity in the manner discussed by Schalén, while the atoms will be relatively unaffected by the encounter. Near a star of early type, however, the hydrogen is ionized, and the large interaction between dust and protons will force the interstellar medium to behave as a uniform homogeneous gas, provided that the velocity of the star is not much greater than 10 km./sec. The radiation pressure on dust near such a star will therefore tend to repel all the constituents of the medium, though the effect is considerably less than would appear if only dust were present. The pressure of radiation on atoms is less important; the radiation pressure per unit mass on interstellar atoms other than H is shown to be less, on the average, than the corresponding force per unit mass on dust. In the case of H the scattering of *La* radiation is so great that a quantum of *La* will diffuse slowly through space and will be absorbed by a dust particle before it has gone more than ⅓ parsec.; radiation pressure on H atoms is therefore negligible. It follows that for any one star the radiation pressure on the dust particles in unit vol. is much greater than that on all the atoms in the same volume. The direct effects of the general galactic radiation field are small. The radiative force on dust particles in the galactic plane will produce a slight difference between the medium as a whole and the stars in the net attraction of each toward the galactic centre, the difference in equilibrium rotational velocities amounting to not more than a few 10ths km./sec. in the neighbourhood of the Sun. If the short time scale is assumed, interaction between dust and atoms will prevent any sorting-out of the different constituents of the medium under the pressure of radiation, either parallel or perpendicular to the galactic plane. The galactic radiation field is indirectly responsible for a force between 2 dust particles. The absorption of radiation by 2 particles will reduce the energy density between them; radiation pressure will therefore push the particles toward each other with a force which varies as the inverse square of the distance. For Fe particles with a radius $< 10^{-7}$ cm. this force is more than 200 × the mutual gravitational attraction of the 2 particles. Author.

2525. Form of gaseous configurations rotating with non-uniform angular velocity. Z. Kopal. *Proc. Nat. Acad. Sci., Wash.*, **27**, *pp*. 359–365, *Aug*., 1941.—A general form is found for the oblateness of a gaseous mass slightly distorted by slow rotation. For constant angular velocity ω the limiting conditions corresponding to Roche's model, Maclaurin's model and the shell model, are applied in turn, and the superficial oblateness is found to be in the ratios 2 : 5 : 10 for the respective density distributions. For non-uniform rotation similar results are obtained, irrespective of the eventual variation of ω in the interior. The oblateness will be greater if ω increases inwards than if it is constant throughout. A consideration of real stars with pronounced density condensations suggests that here, too, the external form is practically specified by ω at the surface and the mean density. A. Hu.

2526. The distances of the reddened B stars. J. A. O'Keefe. *Astrophys. J.*, **94**, *pp*. 353–367, *Sept*., 1941.—The spectral types and luminosities of 179 heavily reddened B stars have been estimated on low-dispersion slit spectrograms. Excluding the reddened Be stars, which may be reddened by intrinsic causes, the reddening of the B stars is attributed to a very patchy layer of absorbing matter. The coefficient of absorption is found to vary rapidly and to reach its highest values in the obvious dark areas. By using the reddened B stars, the distances of the largest dark nebulae are estimated, and the results are compared with the star counts. The agreement is good for the more distant dark nebulae and poor for the nearer ones. This is interpreted as confirmation of the connection of the reddened B stars with the dark nebulae. AUTHOR.

2527. The radial velocities of long-period variable stars. II. P. W. MERRILL. *Astrophys. J.*, **94**, *pp.* 171–214, *Sept.*, 1941.—Measurements of radial velocity were taken from 618 Mt. Wilson spectrograms of 206 long-period variables of spectral classes Me and Se. For 152 of these objects no previous measurements have been reported. The velocities of 305 variables summarize all known measurements. It is recommended that velocities derived from the absorption lines be used in studies of galactic motions. For 72 stars direct measurements of the absorption lines are available; for the other stars the measured emission-line displacements were corrected in the manner described [Abstr. 802 (1924)]. A brief statistical study is given of the types, periods, and galactic latitudes. The galactic motions are discussed. After correction for solar motion, the 305 variables have a group motion, V_0, of 31 km./sec. toward the apex $\alpha=316°$, $\delta=+50°$. When the stars are divided according to the absolute values of the residual velocity, V_0 is only 4 km./sec. for the group with velocities less than 25 km./sec., while for the remaining stars V_0 is 60 km./sec. A somewhat similar result is obtained when the stars are divided according to period of light-variation. On the other hand, when the stars are divided according to distance from the Sun, V_0 is nearly the same for both groups. The apex for the high-speed stars is near that point of the sky toward which stars near the Sun are moving in their galactic orbits. This fact confirms the view that the velocity asymmetry is an effect exhibited by stars having unusually small circular velocities in their galactic orbits. The radial components may be exceptionally large. AUTHOR.

2528. Spectrographic observations of peculiar stars. II. P. SWINGS AND O. STRUVE. *Astrophys. J.*, **94**, *pp.* 291–319, *Sept.*, 1941.—Besides the strong emission lines of H, He I, and He II, RX Puppis is characterized by very intense lines of [FeVII]; other highly ionized elements observed in the spectrum are [Ne V], [Fe VI] and [Ca VII]. The object is very similar to CI Cygni; but the evidence for a late-type component is not as definite. The behaviour of the forbidden lines is discussed. The spectra of T Coronae Borealis, Z Andromedae, RW Hydrae, RS Ophiuchi, and AX Persei combine bright lines of high excitation and late-type spectra. In all cases their line-emission spectra observed in the last few years behave in the same way as in novae in their nebular stages; but the ejection velocities are smaller than in single novae, even of the slow type. The observations of γ Cassiopeiae obtained in 1940 and 1941 were used to determine the contours of the broad lines from the reversing layer. These lines became gradually stronger as the lines produced by the outer shell grew weaker. The optical thickness for continuous radiation of the shell near its max. development was about $r_1=0{\cdot}2$. The spectrum of 14 Comae Berenices consists of (1) an A5 component of moderate luminosity whose H lines show strong Stark effect and whose lines of Mg II, Si II, Fe II, and Fe I show rapid axial rotation and (2) the spectrum of a shell, which is responsible for sharp Hα but which is otherwise weak in H; the shell also gives rise to sharp lines of Ti II, Cr II, Sc II, Ca II, etc., and resembles the spectrum of δ Aurigae, except that H is much weaker and that the excitation temperature is lower. Some spectroscopic peculiarities of the shell may be accounted for by the hypothesis that the pressure within the shell is lower (perhaps by a factor of 10 or 100) than in normal supergiant reversing layers. AUTHORS.

2529. Measurement of emission-line intensity ratios in unstandardized spectra. D. L. EDWARDS. *Observatory*, **64**, *pp.* 136–140, *Oct.*, 1941.—The author describes a method of using, for photometric purposes, stellar spectrograms obtained before plate standardization was adopted as routine procedure. A linear density/intensity relation is assumed, with a contrast factor γ obtained subsequently from similar plates similarly processed. Variations in γ from plate to plate then enter as accidental errors. The effect which an error in the value assumed for γ will have on deduced intensities is evaluated for a typical case, viz. the violet/red ratio for the various emission lines of γ Cas. The accuracy obtained justifies microphotometer measures rather than eye estimates. A. HU.

2530. The spectroscopic orbit of β Lyrae. F. SHERMAN. *Astrophys. J.*, **94**, *pp.* 368–374, *Sept.*, 1941.—By using a method developed by Sterne, a new orbit has been computed for the B8 component of β Lyrae. For the years 1932–1938 covered by the Yerkes observations the unpublished period by Wesserlink (12·92529 days) represents the observations better than does Rossiter's formula. No striking differences have been found between the new elements and those computed by Rossiter. $K=183{\cdot}5$ km./sec.; $\omega=-49°$; $T_0=9{\cdot}534$ days; $e=0{\cdot}024$; and $\gamma=-21{\cdot}2$ km./sec. T_0 is the epoch of the mean longitude, suggested by Sterne. The conventional element T, the time of periastron passage, is 7·768 days. AUTHOR.

2531. Investigations of typical stellar spectra with high dispersion. I. Table of lines in α Cygni. O. Struve and P. Swings. *Astrophys. J.*, **94,** *pp.* 344–352, *Sept.*, 1941.—This paper contains a new table of wavelengths of absorption lines in the spectrum of α Cygni between λ 3 862 and λ 6 550. Authors.

2532. The opacity and continuous emission of the atmosphere of γ Cassiopeiae. R. B. Baldwin. *Astrophys. J.*, **94,** *pp.* 283–290, *Sept.*, 1941. Changes of the emission and absorption contours of Hδ in the spectrum of γ Cassiopeiae are measured and discussed. The variable absorption-wing intensities give determinations of the atmospheric opacity at different times. Prior to 1939 this opacity is found to be too large to be accounted for by the H atoms. It appears to be accompanied by a continuous emission from the shell. Author.

2533. The surface brightness of the Milky Way. E. A. Kreiken. *Astrophys. J.*, **94,** *pp.* 259–270, *Sept.*, 1941.—From the observed numbers of stars in the Selected Areas, as given by van Rhijn, the total amount of integrated starlight L is computed. There is a positive correlation between L and the observed surface brightness. For the visual observations the coefficient of correlation is $+ 0{\cdot}587$, while for the photographic observations it is $+ 0{\cdot}432$. In the lower galactic latitudes the observed surface brightness corresponding to the same value of L rapidly increases. By comparing the mean values for latitudes $\beta \leq | 5° |$ with those for the latitudes $| 12° | < \beta \leq | 20° |$, it appears that in the lower latitudes the surface of an area with a given value of L is about 10 times brighter than that of a surface with an identical value of L in the higher latitudes. The integrated light of the stars is not the only source from which the surface brightness of the Milky Way originates. Even when it is assumed that in the higher latitudes the surface brightness is entirely due to the diffuse light of the stars, in the lower latitudes this diffuse light only accounts for about 10% of the total. The distribution of the stars in space, as derived from the observed luminosity curve, depends systematically on the amount of space absorption. The fraction of the total surface brightness which originates from L rapidly decreases as the amount of space absorption increases. The increase of the observed surface brightnesses corresponding to the same value of L for lower latitudes can be explained as an effect of the increase of the space absorption in the immediate surroundings of the galactic plane or as the effect of the increasing mean distance of the stars toward the lower latitudes. Author.

2534. Galactic and extragalactic studies. XII. The giant globular cluster 47 Tucanae and its long-period variables. H. Shapley. *Proc. Nat. Acad. Sci., Wash.*, **27,** *pp.* 440–445, *Sept.*, 1941.—[See Abstr. 355 (1941)]. Results are given of a new determination of the distance and luminosity of this cluster, and of the absolute magnitudes of its long-period variable stars. Adopting a visual integrated magnitude of 4·5, and an absorption of 0·3 mag. deduced from nebular counts in the neighbourhood, a value of 7 200 parsecs is obtained for the distance and — 10·2 for the abs. magnitude. This places the system amongst the smaller galaxies in brightness and presumably in mass. A. Hu.

2535. Mystery of β Lyrae. O. Struve. *Amer. J. Phys.*, **9,** *pp.* 63–80, *April*, 1941.—The author gives a non-technical account of recent spectroscopic and dynamical work on this system, which is now believed to be a 13-day close binary consisting of a B9 supergiant and an F star which is so much fainter that it does not contribute to the observed spectrum. Tidal elongation of the supergiant produces contact between the atmospheres, and matter erupts from the hot star, some travelling round the surface of the cooler one and returning, but the greater part spiralling out into space in a widening arm. The light variation is due to the total and annular eclipses combined with the tidal effects. The nebulous spiral arm is responsible for the secondary absorption (quasi-B5) spectrum, whilst the matter travelling in a trajectory close to the F star produces the red and violet satellite lines. A. Hu.

2536. Spectrophotometric observation of ζ Aurigae by an objective-prism spectrograph. Y. Fujita. *Proc. Phys.-Math. Soc., Japan*, **23,** *pp.* 527–534, *July*, 1941.—Equivalent widths of 36 lines of Ca II, Cr, Fe, Ti and H, are measured on 7 spectrograms of this star obtained during the total eclipse of 1939–40. It is deduced from the measures of the K line that the density distribution of Ca ions with height h in the atmosphere follows the law $n \propto (h - h_0)^m$, where m is between 2 and 3. A. Hu.

2537. An analysis of methods for determining the elements of eclipsing binaries. Z. Kopal. *Astrophys. J.*, **94,** *pp.* 145–158, *Sept.*, 1941.—The basic idea of Russell's well-known method is to determine the ratio of radii k with the aid of 1 or 2 fixed points of the light curve and of tables devised specifically for this purpose. The adoption of fixed points is not essential to the orbital problem. The ratio of radii and the remaining geometrical elements of a system can be determined simultaneously by a simple graphical procedure. The main objection to the applicability of Russell's method for partially eclipsing systems concerns the choice of k as the principal parameter defining a curve. With diminishing depth of the eclipse k becomes progressively less and less determinate until attempts at determining k may lose any meaning. The only parameter which light-curves of partial eclipses define with any accuracy is $r_1r_2/\sin^2 i$, not the ratio of the radii. Analytical and graphical methods for determining this quantity by rapidly convergent successive approximations are discussed. AUTHOR.

2538. Theoretical light-curves of close eclipsing systems. I. Z. KOPAL. *Astrophys. J.*, **94**, *pp*. 159–170, *Sept.*, 1941.—The paper investigates effects upon light-curves of eclipsing systems, within their min., which arise from the departures of the eclipsing component from spherical shape. The eclipsed star is supposed to remain spherical and to appear as a disc which is uniformly bright or darkened at the limb to any arbitrary degree. The form of the eclipsing component is supposed to be one of equilibrium under instantaneous rotational and tidal forces and to be known from the theory as far as the effects of the 2nd, 3rd and 4th spherical harmonic deformations are concerned, i.e. as far as the disturbing action of the eclipsed star can be regarded as being due to a mass point. Photometric implications of the distortion are investigated to the same degree of accuracy to which the form of the eclipsing body is known. After a brief general survey the equations of the problem are set up and are solved in a finite number of terms; the last part contains a more general discussion. The present results are directly applicable to reality whenever the physical conditions in any eclipsing system are such that the distortions of both components are likely to be very unequal. Deep min. of typical Algol systems afford a good example. AUTHOR.

2539. Overtone pulsations for the standard model. M. SCHWARZSCHILD. *Astrophys. J.*, **94**, *pp*. 245–252, *Sept.*, 1941.—The periods of the first 4 spherically symmetrical overtone pulsations are derived for the standard model. AUTHOR.

2540. The apsidal motion in binary stars built on a point-source convective-core model with varying guillotine factor. L. MOTZ. *Astrophys. J.*, **94**, *pp*. 253–258, *Sept.*, 1941.—The apsidal motion for binary stars built on a point-source convective-core model with varying guillotine factor is calculated by numerical integration up to the 5th harmonic of the surface distortion. It is found that the point-convective model behaves, with respect to apsidal motion, very nearly like a polytrope of index 3·48. For the 5 eclipsing binaries for which observations are available the polytropic indices corresponding to the observed apsidal motion agree fairly well with the value found for the point-source convective-core model. AUTHOR.

2541. Tidal attack on the Cepheid problem. W. A. LUBY. *J. Roy. Astr. Soc. Can.*, **35**, *pp*. 293–306, *Sept.*, 1941.—It is suggested from dynamical considerations that a Cepheid is a binary star with a period of revolution equal to the light period. The companion is assumed to be of smaller mass but greater density than the primary. The cause of the light variation and of the velocity variation is the rise and fall of the enormous primary tide on the bright star, whilst the orbital motion of the primary is a vital factor in the velocity lag at light max. and min. The period/luminosity law is derived directly from the hypothesis, and the detailed shapes of the various light curves are also tidally interpreted. A. Hu.

SUN.

2542. The motion of gases in the Sun's atmosphere. II. On the westward tilt of prominences. A. K. DAS AND B. G. NARAYAN. *Indian J. Phys.*, **15**, *pp*. 15–26, *Feb.*, 1941.—[See Abstr. 1193 (1941)]. From measurements of 1 346 absorption markings the authors find that prominences are rarely perpendicular to the sun's surface. The majority of prominences have a tilt towards the west of the vertical, although there are cases of eastward tilt and no tilt. The average tilt found, by proper weighting, from all the measurements is 8°W. An explanation of the origin of the tilt is offered; and on the basis of this explanation it is suggested that most stable prominences probably originate in the deep interior of the Sun. AUTHORS.

2543. Polarization of the corona. C. W. ALLEN. *Mon. Not. Roy. Astr. Soc.*, **101**, 5–6, *pp*. 281–283, 1941.—Photometrically standardized photographs of the solar corona were obtained through a polaroid screen and blue and red colour filters during the total eclipse of 1940, October 1. The equipment and the method of calibration used are described, and the application of various photometric corrections is discussed. The polarization is found to be almost independent of colour (43% for a band 500 Å wide centred on 6 250 Å, and 41% for a 600 Å band centred on 4 600 Å), and almost independent of limb distance from 7′ to 40′. A. Hu.

2544. Theory of a polarization effect in Fraunhofer lines due to oscillator scattering. H. ZANSTRA. *Mon. Not. Roy. Astr. Soc.*, **101**, 5–6, *pp*. 250–265, 1941.—The scattering of light within a spectral line in a stellar atmosphere is treated under the assumption that the scattering centres behave like classical oscillators. The line depth is assumed to be small (weak lines or line wings), so that Unsöld's procedure can be followed. The most important respect in which the classical oscillator is found to differ from an isotropic scatterer is that the light within the line should be polarized, to an extent depending on the position on the disc and the coefficient of darkening. This effect is sufficiently large to be observed on the Sun. The line 4 227 Å of Ca is suggested as suitable. For the Schuster-Schwarzschild model the expected effect at the limb is 37% for this line, whilst for the Milne-Eddington model it is 11%. At a distance from the limb of 2% of the solar radius the effect should be 16% and 5% in the two cases. [See Abstr. 2273 (1941)]. A. Hu.

2545. The grating infra-red solar spectrum. III. Rotational structure of the carbon dioxide (CO_2) band ν_2 at 13·9 μ. IV. Rotational structure of the 2 difference bands of CO_2 near 10 μ. A. Adel. *Astrophys. J.*, **94**, *pp.* 375–380, *Sept.*, 1941.—The rotational structure in the positive branch of the band $[(\nu_1, 2\nu_2) - \nu_2]$, centred at 13.9 μ, is extensively developed in the solar spectrum between 13.9 μ and 13.0 μ. Rotational levels through quantum number $J = 64$ are represented. The rotation lines are satisfactorily ordered by the expression $\nu\,\text{cm.}^{-1} = 720.71 + 0.789\,N - 0{\cdot}000\,51\,N^2$, where N is the ordinal number of the line. The equilibrium moment of inertia of the CO_2 molecule deduced from the observations is $A = 70.8 \times 10^{-40}$ g. cm.^{2}, in agreement with laboratory determinations and with the value obtained from the CO_2 bands in the spectrum of Venus. The low transmission of the terrestrial atmosphere between the alternative long-wavelength limits of transmission (13·9 μ and 13·5 μ) is evident in the grating solar spectrum of this region.—The rotational structure of the 2 difference bands of CO_2 at 9·4 μ and 10·4 μ is present in the grating solar spectrum. Weakly absorbed in our atmosphere, intensely radiated by the atmosphere of Venus, these bands are of fundamental importance in the measurement and analysis of the temperature radiation from that planet. [See Abstr. 1473 (1941)]. Authors.

2546. A search for phosphorus compounds in the Sun, α Bootis and β Pegasi. D. N. Davis. *Astrophys. J.*, **94**, *pp.* 276–282, *Sept.*, 1941.—The presence of P_2, PN, and PO cannot be discussed, because the strongest bands lie beyond λ 2 800. No considerations, either physical or statistical, support Nicolet's conclusion that there are PH lines in the solar spectrum. Existing material for α Bootis definitely does not support the conclusion that PH is in this star. The analysis of coincidences with lines in the spectrum of β Pegasi has failed to yield favourable evidence for the presence of PH. Although measurements of the CP band which should be strongest in absorption are not available, the coincidences of solar lines with lines of the (2, 0) and (0, 1) bands show that CP may be present in the Sun. Author.

2547. Selective absorption in space near the Sun. J. Stebbins, C. M. Huffer and A. E. Whitford. *Contr. Mt. Wilson Obs. No.* 650. *Astrophys. J.*, **94**, *pp.* 215–225, *Sept.*, 1941.—The colours of A stars down to the limit of the Henry Draper Catalogue within 10° of the north pole of rotation and 30° of the north and south galactic poles have been measured with a photo-electric cell at Madison or at Mt. Wilson. The colour scale is that of the previously measured B stars. The spectra of the stars at the north pole have been reclassified by Keenan and Babcock at Yerkes, and those at the galactic poles at Mt. Wilson. It is found that the Draper spectra are classified systematically ~~too~~ early in the faint magnitudes. Toward the north pole of rotation the selective absorption on the photo-electric scale is found to be $c = +0{\cdot}21 \pm 0{\cdot}02$ mag./kpc., and toward the galactic poles $c = +0{\cdot}11 \pm 0{\cdot}05$ mag./kpc. These and the previous results from B stars indicate that the Sun is in a fairly uniform layer not more than 500 parsecs in thickness, giving a total photographic absorption of about 1 mag./kpc. Authors.

See also Abstract 2621.

GEOPHYSICS.

GEODESY.

2548. Locating the principal point of precision airplane mapping cameras. F. E. Washer. *Bur. Stand. J. Res., Wash.*, **27**, *pp.* 405–412, *Oct.*, 1941.—The location of the principal point with respect to the intersection of lines joining opposite pairs of collimation index markers was determined for numerous precision aeroplane mapping cameras. Weak prism effect, present in most camera lenses, was measured with the Bureau's precision lens-testing camera and its influence on the location of the principal point considered. It was found that these cameras required adjustments ranging from 2 to 25 times the allowable tolerance of ± 0·03 mm. in the location of the principal point. Author.

METEOROLOGY.

2549. Temperature of meteors and density of the upper atmosphere. J. Hoppe. *Met. Z.*, **56**, *pp.* 304–307, *Aug.*, 1939. *In German.*—The author discusses the possibility of investigating the physical state of upper atmospheric layers by means of meteoric observations. Assuming adiabatic compression, considerably higher temperatures are found than according to the theory of Lindemann and Dobson [Abstr. 1069 (1923)]. On the other hand, it is probable that adiabatic compression does not occur and that the radiation of meteors is caused by luminescence. R. N.

2550. Daily solar radiant energy at the exterior of the atmosphere. R. E. Kennedy. *Mon. Weath. Rev., Wash.*, **69,** *p.* 145, *May*, 1941.—Curves are given showing the total daily solar radiation on a horizontal surface at the exterior of the atmosphere. The data are given in B.Th.U./in.^{2} day, and the curves are based on a solar constant of 1·94 cal./cm.^{2} min., the ordinates being degs. N. latitude and solar declination. A. Hu.

2551. Heat radiation from the atmosphere at Bombay and its comparison with that at Poona. R. Narayanaswami. *Sci. Notes Met. Dep. India*, **8,** 93, *pp.* 99–112, 1941.—Daily measurements of the net loss of heat by radiation from a black surface exposed to the sky were made at Bombay during the period March, 1937, to October, 1938, with an Ångström's pyrgeometer. Simultaneous observations of temperature, vapour pressure and cloudiness, were also recorded. From the net radiation the radiation received from the atmosphere is calculated and its variations with season, cloudiness and state of weather, are discussed. The results are compared with those obtained at Poona. Net radiation from a horizontal surface and the depression of the grass min. temperature below that of the Stevenson screen min. are correlated. A brief discussion is made of the conditions under which abnormally low or high values of sky radiation are observed. Author.

2552. Summary of total solar and sky radiation measurements in the U.S.A. I. F. Hand. *Mon. Weath. Rev., Wash.*, **69,** *pp.* 95–125, *April*, 1941.—Radiation data from 15 pyrheliometer stations distributed equitably over the U.S. are presented in tabular form as well as graphically by 18 isopleths. The observations were made almost exclusively on Eppley thermo-electric pyrheliometers, used in conjunction with recording potentiometers or microammeters, and extend usually over the 4 years 1936–39, though longer records are available from some long-established stations. The results are briefly discussed in relation to the incidence of cloud and smoke at the various stations. A. Hu.

2553. Records of solar and sky radiation in the Allgäu. O. Hoelper. *Met. Z.*, **56,** *pp.* 333–342 *Sept.*, 1939. *In German.*—The annual and diurnal changes of the solar and sky radiation in the Small Walser Valley are tabulated. Measured values of radiation are combined with statistical data concerning frequency and duration of sunshine. Isopleths are drawn for solar and sky radiation showing the percentage frequency of the total irradiated heat per day for the different months. R. N.

2554. Correlation between frost and the preceding meteorological conditions. II. Jaipur. B. Ali and S. N. Naqvi. *Sci. Notes Met. Dep. India*, **8,** 92, *pp.* 91–98, 1941.—Observations made at 1 600 hr. (local time) at Jaipur during the period 1918–1929 have been analysed statistically and equations developed between the min. temperature reached during the night and the dew point, dry-bulb, wet-bulb and max. temperatures on the preceding afternoon. The physical significance of these statistical equations is discussed. The observed and calculated values of min. temperature agree closely in over 94% of the cases. The discrepancies in the remaining 5 or 6% are generally not large and the causes producing these are discussed. Conditions most favourable for the occurrence of frost at the station are stated. The present paper confirms the result brought out by the previous paper [Abstr. 1877 (1932)], in which the data of Lahore were analysed, that, for the forecasting of min. temperature, the single factor, wet-bulb temperature, is as good as many dual combinations of functions of temperature and vapour pressure. Authors.

2555. Nocturnal temperature minima in furrows with different gradients of slope. K. Brocks. *Met. Z.*, **56,** *pp.* 378–383, *Oct.*, 1939. *In German.*—Temperature min. were measured during 138 nights in 6 furrows of 20 cm. depth with gradients of slope of 15°, 30°, 75°, 60°, 75° and 90°, and equal width at the base. Compared with neighbouring measurements near the undisturbed ground, a temperature rise was found, the larger the steeper the gradient. This is partly due to the heat flux from the higher soil layers and partly to the screening effect of the walls of the furrows, which prevents radiation: A cooling effect was only observed if the heat exchange between the upper layers of the soil and the air next to the ground was prevented, e.g. by a snow cover. R. N.

2556. Equivalent potential temperature. H. Arakawa. *Met. Z.*, **56,** *pp.* 307–311, *Aug.*, 1939. *In German.*—Equations and tables are given for determining the pressure from equivalent potential temperatures and air temperature for the states of rain and snow. R. N.

2557. On the relation of the ageostrophic component of wind velocity to the isallobaric field. F. A. Berson. *Met. Z.*, **56,** *pp.* 329–333, *Sept.*, 1939. *In German.*—The vectorial difference between the actual wind velocity and the geostrophic wind velocity has been shown to be parallel to the isallobaric lines $\partial p/\partial t = \text{const.}$ This is explained by the greater number of observations of anticyclonic curvature in the statistical data available. In the calculations the local time derivative of the individual acceleration is supposed to be negligible. This involves the local invariance of the ageostrophic velocity component and furnishes a relation of the isallobaric field of the second order, $\partial p^2/\partial t^2 = \text{const.}$, which may be tested by observation. R. N.

2558. Deviation from geostrophic wind. H. Phillipps. *Met. Z.*, **56,** *pp.* 460–483, *Dec.*, 1939. *In German.*—The significance of the geostrophic deviation for dynamics of the atmosphere is discussed, and a generalization is given of the theory of Brunt and Douglas [Abstr. 727 (1929)], making it applicable to cyclonic states of weather. The local changes in the pressure gradient field are taken into consideration and the new theory agrees well with experience. R. N.

2559. Notion and significance of dynamic pressure. J. Küttner. *Met. Z.*, **56,** *pp.* 361–364, *Oct.*, 1939. *In German.*—Only those pressure differences which result from accelerations should be termed dynamic. Usually dynamic pressures are small, and negligible compared with static pressures. Only hurricanes of large height will cause dynamic pressure effects comparable to static effects. In small-range phenomena, e.g. leeside eddies, dynamic pressures are effective. Alternatively, the author recommends the use of "convective" instead of "dynamic" heating, cooling and pressure change. R. N.

2560. An extension of the concept of symmetry of air pressure curves. E. Wahl. *Met. Z.*, **56,** *pp.* 445–452, *Dec.*, 1939. *In German.*—A new form of Stumpff's criterion for symmetry is derived which permits elimination of secular changes. The significance of this criterion is explained by some examples and the deductions are discussed to which the simultaneous calculation of both criteria leads in interpreting the symmetries. The influences of long and short waves in the trend of air pressure are separated. Thus the notion of symmetry may be better adapted for forecasting. R. N.

2561. Singular advection and movement of cyclones. H. Ertel. *Met. Z.*, **56,** *pp.* 401–407, *Nov.*, 1939. *In German.*—The difficulties arising from the existence of turbulence friction lead to a replacement of the notion of the tropopause as a zero-order discontinuity surface of the impulse density field by a discontinuity field of the first order. This makes it possible to determine the direction and speed of cyclonic movement. The pressure change at the bottom is represented by the superposition of a translation of the initial isobaric field and a term dependent on the barometric average temperature of the troposphere, the dynamic topography of, and the stability leap at, the tropopause. R. N.

2562. Weather symptoms and weather forecasting. F. Löhle. *Met. Z.*, **56,** *pp.* 383–387, *Oct.*, 1939. *In German.*—While practical weather forecasting by shepherds, foresters and farmers, is based on a comprehensive grasp of the results of long experience, science tries to get a deeper insight into the phenomena by accurate observation, careful description and satisfactory explanation. As examples, the significance of cirrocumulus clouds, of layers of haze and of the blue of the sky for weather forecasting is discussed. The single phenomenon should always be considered in connection with the broader weather-conditioning agents. R. N.

2563. The wet adiabatic. Contribution to the theory of adiabatics. O. Dinkelacker. *Met. Z.*, **56,** *pp.* 289–297, *Aug.*, 1939. *In German.*—The irreversible condensation process is reduced to the reversible process of the dry adiabatic. Thus the different notions of condensation adiabatics are clarified. The relations to the pseudo- and pseudo-potential temperatures are made apparent. The equivalent and equivalent-potential temperatures are shown to be approximations. A uniform and illustrative picture of the adiabatics is given in closed form, amenable to calculation. R. N.

2564. Rain drop formation in pure water clouds. W. Findeisen. *Met. Z.*, **56,** *pp.* 365–368, *Oct.*, 1939. *In German.*—Theoretical considerations show that raindrops of normal size are not formed by continuous condensation nor by coagulation. Although the coagulation theory may be applicable to small droplets, for larger-sized drops observed facts contradict the theory. Larger drops are formed only by the melting of ice particles. R. N.

2565. Evaporation of cloud and rain drops. W. Findeisen. *Met. Z.*, **56,** *pp.* 453–460, *Dec.*, 1939. *In German.*—Formulae are derived for the speed of evaporation of cloud and rain drops, and the evaporation times and distances of fall are determined. The results are explained by numerical examples and their significance is discussed. [See Abstr. 1091 (1938)]. R. N.

2566. Condensation phenomena in the free atmosphere. M. Paul. *Met. Z.*, **56,** *pp.* 297–300, *Aug.*, 1939. *In German.*—A qualitative discussion of the energy exchanges taking place during the wet adiabatic change of state. In a strict sense the latter is only to be assumed in those boundary cases where droplets remain suspended in the wet air for a sufficient time. For a deeper insight into the condensation phenomena in the free atmosphere molecular kinetics, especially the action of van der Waals forces, must be considered. R. N.

2567. Heavy snowfalls in Germany, especially the snow cloudburst of April 16th, 1936. W. Kuhnke. *Met. Z.*, **56,** *pp.* 418–428, *Nov.*, 1939. *In German.*—Heavy snowfalls are defined as those in which more than 15 mm. is measured in 24 hrs. The 57 heavy snowfalls recorded between 1705 and 1936 are discussed with regard to local distribution, frequency and intensity. The climatic conditions leading to heavy snowfalls are investigated and the possibility of forecasting is discussed. A table shows the phenomena to be mainly affected by slow-moving cyclones with opposing cold and warm air onrushes. R. N.

2568. Snow observations for aeronautical meteorology. W. Findeisen. *Met. Z.*, **56,** *pp.* 429–435, *Nov.*, 1939. *In German.*—The crystalline or crystallinic structure of snow particles leads to conclusions with regard to the aerologic conditions in which the particle was falling. Thus, from observations of snow and its structure practical hints may be gained concerning weather phenomena of aeronautical portent. When assessing the results of snow observations the general state of weather must be taken into consideration. R. N.

2569. Lightning and hail. (On the electrical nature of thunderstorms.) F. Rossmann. *Met. Z.*, **56,** *pp.* 372–378, *Oct.*, 1939. *In German.*—Observations of thunderstorms combined with experiences gained by disturbances of radio transmission in the arctics establish the importance of the contrast of water and ice clouds for the formation of thunderstorms. The questions of the generation of the strong electric fields leading to lightning are discussed. R. N.

2570. Temperature and pressure dependence of the sp. hts. of air and steam and of the latent heat of steam. F. Schnaidt. *Met. Z.*, **56,** *pp.* 300–304, *Aug.*, 1939. *In German.*—The applicability of the ideal equation of state for steam is investigated and the following is established by thermodynamic considerations: For meteorological questions the sp. hts. may be assumed as independent of temperature unless very high accuracy is required. The dependence of the lat. ht. of steam on temperature should not be neglected. Its dependence on pressure is small at temperatures encountered in meteorology. R. N.

2571. Energy economy of the earth in the course of a year and in the earth's history. W. Wundt. *Met. Z.*, **56,** *pp.* 325–329, *Sept.*, 1939. *In German.*—The author makes a rough estimate of the abs. values of the heat balance at the surface of the earth and compares the annual values of heat exchange with the changes that have occurred since the glacial period. The annual exchange is considerably greater than the variations of energy in sea and glaciers if extended over long periods. The storing capacities of the atmosphere and the soil are comparatively small. The change from glacial to warm periods is stated to be due to changes in the intensity of reflection of the earth's surface. The estimated income and expenditure values of the heat balance are tabulated in units of 10^{22} cal. R. N.

2572. Climate of the Oetz Valley. E. Ekhart. *Met. Z.*, **56,** *pp.* 347–349, *Sept.*, 1939. *In German.*—Temperature, humidity, v.p., cloudiness, duration of sunshine and rain- or snowfall as observed during 4 years, and the wind conditions, are tabulated and discussed. R. N.

2573. A spectrophotometric study of the light of the night sky. H. W. Babcock and J. J. Johnson. *Astrophys. J.*, **94,** *pp.* 271–275, *Sept.* 1941.—A spectrophotometric comparison of the night sky and M 31 shows that the night sky is relatively much stronger than the nebula in ultraviolet light and suggests that for nebular photography improved contrast may be obtained by the use of a filter to remove ultra-violet light. An extensive series of intensity measurements of night-sky radiations shows that no marked variations may be expected within a single night, in the absence of polar auroras, but that on occasional nights the sky is extraordinarily bright, thus greatly reducing the efficiency of direct photography. If periods of unusual activity are excepted, λ 5577 and the red pair of lines at λ 6300 and λ 6364 seem to vary in a complementary fashion throughout a given night, but over longer intervals all radiations tend to vary similarly and together. Authors.

2574. The brightness of the zenith sky during twilight. M. W. Chiplonkar. *Proc. Indian Acad. Sci. A.*, **14,** *pp.* 70–79, *July*, 1941.—A visual photometer is described for measuring the brightness of the zenith sky during twilight. The results of measurements made with it at Bombay on a large number of clear moonless evenings during the period December, 1937, to March, 1938, are discussed. A red filter RG_1 (Schott and Gen.) and a green filter VG_1 (Schott and Gen.) were used. With the latter it was possible to continue observations even when twilight conditions had completely ceased. The variations in brightness agree with a relation proposed by Link, namely, $dI/I = \beta \sin\theta \sec^2\theta d\theta$, where I is the brightness of the zenith sky, θ the angular depression of the Sun below the horizon and β a constant. If the brightness is due only to primary scattering from the atmosphere illuminated by sunlight, it is possible to connect β with the temperature of the atmospheric layer responsible for the scattering.

The difficulty, however, is to ascertain to what extent secondary scattering is important. AUTHOR.

2575. Measurements of the blue of the sky. W. KRAMER. *Met. Z.*, **56**, *pp.* 408–415, *Nov.*, 1939. *In German.*—The results obtained by different methods of measurement are reviewed and physical and physiological conditions are discussed. How far these conditions may be fulfilled is shown in connection with Ostwald-Linke's 'blue' standard. A simple and cheap 2-colour measuring method is described which allows of determining with sufficient accuracy the colour and brightness of the blue of the sky in comparison with sunlight. R. N.

2576. Contributions to the measurement of visibility. R. MECKE. *Met. Z.*, **56**, *pp.* 369–372, *Oct.*, 1939. *In German.*—For the measurement of visibility a number of notions are defined relating to the atmospheric state, the object viewed and the receiving subject (eye, photographic plate, photocell). The visibility is formed by the product of norm value and visibility constant, the former depending on atmospheric conditions, the latter on the threshold value of the receiver and the contrast value of the object. R. N.

2577. The green flash. R. MEYER. *Met. Z.*, **56**, *pp.* 342–346, *Sept.*, 1939. *In German.*—The green flash at sunrise and sunset, first described by Winstanley in 1873, has lately been dealt with in a number of Dutch publications. These are reviewed. A distinction is made between green segment, green fringe and green flash proper, the probable causes of which are discussed. A programme is given for future investigations. R. N.

2578. Experiments on temperature dependence of infra-red absorption of moist air. G. FALCKENBERG. *Met. Z.*, **56**, *pp.* 415–417, *Nov.*, 1939. *In German.*—With the apparatus previously described [Abstr. 2034 (1941)] the absorption of black radiation in the infra-red frequency range by moist but CO_2-free air was measured in an absorption tube of 2·37 m. length at temperatures of 20°C. and 100°C. The influence of line broadening was found to be stronger than that of Boltzmann's factor [see Abstr. 2902 (1939)]. R. N.

***2579. Characteristics of the Eppley pyrheliometer.** B. WOERTZ AND I. F. HAND. *Mon. Weath. Rev., Wash.*, **65**, *pp.* 146–148, *May*, 1941.—Direct calibration against a silver-disc pyrheliometer, as well as calibration with a lamp mounted equatorially to simulate a non-variable sun, have established that an Eppley instrument, though carefully erected, may be as much as 1½° off horizontal. A new levelling technique is advocated in order to remove the gross errors due to this cause. Smaller defects are due to varying incidence angles, to bulb imperfections, to the black and white rings being neither coplanar nor plane, and to uneven coating of the black surfaces. In normal use these errors are best allowed for by using a variable calibration factor, for the calculation of which directions are given. A. Hu.

***2580. A recording wind-direction indicator.** D. C. GALL. *J. Sci. Instrum.*, **18**, *pp.* 219–221, *Nov.*, 1941.—A recording wind indicator is described, in which the angular direction of the wind vane electrically controls an ink record at any distance. The record is in rectangular co-ordinates and provides for an overlap of 90° in the orientation of the vane to allow for fluctuations in wind directions. The mechanism to effect this overlapping record is described. AUTHOR.

***2581. The radiosonde: the stratosphere laboratory.** E. T. CLARKE AND S. A. KORFF. *J. Franklin Inst.*, **232**, *pp.* 217–238, *Sept., and pp.* 339–355, *Oct.*, 1941.—[Abstr. 1812 B (1941)].

SEISMOLOGY.

2582. The Hindu Kush earthquake of Nov. 21, 1939. S. M. MUKHERJEE AND A. R. PILLAI. *Sci. Notes Met. Dep. India*, **8**, 91, *pp.* 85–90, 1941. —The epicentre is obtained as 36°11′N. and 70°53′E., in the Hindu Kush. The depth of focus as determined is 210 ± 14 km., and the hypocentral time 11 h. 01 m. 43s. G.M.T. The various characteristics observed in respect of this shock are discussed and are found to be essentially similar to those of the previous deep ones from the same region. The possibility of getting useful information regarding the origin of these shocks from a careful study of their seismograms obtainable at a single Indian station is pointed out. It is found that strong shocks occur generally in winter and weak ones in all the seasons. Frequency of occurrence of both the classes is 2 per year. The phase *sP* is specially strong in the Indian seismograms being recorded at 8°, the smallest epicentral distance at which seismograms were available for this study. AUTHORS.

See also Abstract 2513.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

2583. The measurement of the potential gradient and the space charge in the free atmosphere. W. MECKLENBURG AND P. LAUTNER. *Z. Phys.*, **115**, 9–10, *pp.* 557–570, 1940. *In German.*—A particularly small and stable recording electrometer is developed for the measurement of the potential gradient in the free atmosphere. This instrument is thrown from an aeroplane with a parachute or used in a glider. The measurements which have been extended up to 3 000 m. altitude give the potential gradient as a function of the altitude, and consequently the space charge. Both quantities are strongly affected by the weather conditions. O. O.

RADIOACTIVITY.

2584. Molybdenum-thorium. H. Nelting. *Z. Phys.*, **115**, 7–8, *pp.* 469–480, 1940. *In German.*—The activation of Mo-Th is investigated at various temperatures. The diffusion of Th through Mo is found to be in agreement with the values given by Dushman. O. O.

2585. Safe handling of radioactive luminous compound. *Handb. U.S. Bur. Stand., No. H*27, [15 *pp.*], 1941.

***2586. Radiations from radioactive cobalt.** A. S. Jensen. *Phys. Rev.*, **60**, *pp.* 430–434, *Sept.* 15, 1941.—A cloud chamber has been built and is briefly described. It has been used for measuring the energies of the radiations from the long-lived Co isotopes, $Co^{56,58}$, formed by deuteron bombardment of Fe. A positron spectrum with a max. energy of 1·36 ± 0·10 eMV was observed on the histogram. The K-U plot of the data suggests also another spectrum with an energy end point near 0·5 eMV. One internally converted γ-ray near 0·1 eMV was observed in the cloud chamber and resolved into 2 lines at 117 ekV and 130 ekV, respectively, by a magnetic spectrograph. Higher-energy γ-rays less intensely internally converted are suggested. The histogram from a sample of Co^{56} produced by bombarding manganese with α-particles definitely assigns the higher-energy positron spectrum to the isotope Co^{58}. Author.

2587. Artificial radioactivity of Ti^{45}. J. S. V. Allen, M. L. Pool, J. D. Kurbatov and L. L. Quill. *Phys. Rev.*, **60**, *pp.* 425–429, *Sept.* 15, 1941.—A radioactive isotope possessing a half-life of 3·08 ± 0·06 hr. has been produced by 4 different types of bombardment. Evidence is presented which indicates that the activity should be assigned to Ti^{45}. The 4 nuclear reactions are: $Ca^{42}+He^4 \rightarrow Ti^{45}+n^1$; $Sc^{45}+H^1 \rightarrow Ti^{45}+n^1$; $Sc^{45}+H^2 \rightarrow Ti^{45}+2n^1$; $Ti^{46}+n^1 \rightarrow Ti^{45}+2n^1$. Nuclear spin considerations indicate that a 5th reaction, $Ti^{46}(\gamma,n)Ti^{45}$, is improbable, as was verified experimentally. Analysis of cloud-chamber pictures reveals the max. positron energy to be 1·2 eMV. On a Sargent diagram the reaction $Ti^{45} \rightarrow Sc^{45}+e^+$ is a permitted one. The ½-life of 3·08 ± 0·06 hr. for Ti^{45} is the weighted average of 3·17, 3·10, and 3·02 hr. from $Sc(p,n)$; 3·04 hr. from $Sc(d,2n)$; 3·17 hr. from $Ca(\alpha,n)$; 3·0 hr. from $Ti(n,2n)$. Authors.

2588. Energy and multi-pole order of nuclear γ-rays. A. C. Helmholz. *Phys. Rev.*, **60**, *pp.* 415–424, *Sept.* 15, 1941.—The energies of some nuclear γ-rays emitted in deuteron-induced radioactivities have been measured with a magnetic β-ray spectrograph with photographic film as detector. The energies measured were those of the conversion electrons, and in some cases also those of the photo-electrons ejected from a heavy element. Independent measurements of the multipole order have been obtained where possible from the internal conversion coefficient, the K/L conversion ratio, and the lifetime of the γ-ray transition. In the case of 8 out of the 14 γ-rays measured a fairly definite assignment of the multipole order has been made. In the nuclei Zn^{69}, Kr^{83}, Sr^{87}, and $Ag^{107 \text{ or } 109}$ the probable nuclear spins of the states involved are given. Author.

See also Abstract 2595.

RADIATION.

ABSORPTION.

2589. Effects of hydrochloric acid and salts on the absorption of light by β-naphthoquinonesulphonic acid. B. Wingfield and S. F. Acree. *Bur. Stand. J. Res., Wash.*, **27**, *pp.* 361–370, *Oct.*, 1941.—In order to evaluate the effects of HCl and neutral salts on the absorption of light by an organic acid dye, spectrophotometric measurements were made of a series of solutions of HCl and of neutral salts + HCl, each containing $3 \times 10^{-4}\,M$ β-naphthoquinonesulphonic acid. The dye in these solutions showed small differences in spectral absorption. Similar differences may contribute to the changes of absorption shown by true indicators. Most of the data were compatible with the assumption that new absorption bands were not produced or that there was no considerable shift in the position of the original bands with respect to wave number. The increase in the absorption by the dye in the presence of salts was $\propto \sqrt{\text{molar activity}}$ of the electrolyte. The proportionality factor was different for each salt and varied from 0·144 to 0·353. The results suggest that the specific effects of ions on the absorption indices of positive, neutral and negative forms, of an indicator must be taken into account, as well as the normal effects of the ions on the dissociation of the indicator, for accurate pH measurements. Authors.

See also Abstract 2578.

COLORIMETRY.

2590. Decoloration of alkali halide crystallites. H. Kurzke and J. Rottgardt. *Ann. Phys., Lpz.*, **39**, 8, *pp.* 619–632, 1941. *In German.*—The authors investigate the effect of moisture in the air as a cause of the decoloration of coloured alkali halide crystals, using mainly KBr. The coloration of the crystals and the preparation from them of the crystallites are described. The method of separating the crystal powder into grains of different sizes, and their size determination, is given. The results of decoloration tests are given in curves. Curves also show the time of decoloration as a function of moisture with constant grain size and the results of measurements on the absorption of light as a decolouring cause. In the theoretical considerations and discussion of the results of the measurements formulae are developed relating decoloration time and grain size. The theoretical results agree well with the observations. H. G. S.

2591. Colour analysis and colorimetry. I. Nitrate estimation. G. V. L. N. Murty. *Proc. Indian Acad. Sci. A*, **14**, *pp.* 43–47, *July*, 1941.—The analysis of colours met with in the colorimetric estimation of nitrate by the phenol sulphonic acid and the α-naphthol sulphonic acid reagents has been effected by means of the Keuffel and Esser colour analyser. From the results of colour analysis as well as those of colorimetric estimations it has been shown that the α-naphthol sulphonic-acid method and the phenol sulphonic-acid method are both complementary, each adding to the utility of the other by being efficient in its own range of concentration. Author.

2592. Central notations for ISCC-NBS colour names. D. Nickerson and S. M. Newhall. *J. Opt. Soc. Amer.*, **31**, *pp.* 587–591, *Sept.*, 1941.

2593. Brightnesses of light sources. W. E. Forsythe and E. M. Watson. *Gen. Elect. Rev.*, **44**, *pp.* 489–491, *Sept.*, 1941.

See also Abstract 2575.

EMISSION.

***2594. A simplified method for verifying the Stefan-Boltzmann law of radiation and determining the Stefan constant.** P. A. Constantinides. *Amer. J. Phys.*, **9**, *pp.* 87–93, *April*, 1941.—The radiator, thermometer and radiometer, of other methods are replaced by a wire of known melting temperature, and the measurement of the energy radiated is reduced to simple voltmeter and ammeter readings. H. H. Ho.

2595. The theory of cascade showers in heavy elements. H. C. Corben. *Phys. Rev.*, **60**, *pp.* 435–439, *Sept.* 15, 1941.—The 1-dimensional equations of the cascade theory of showers are solved, account being taken of the variation with energy of the cross-section for pair production, as well as ionization and bremsstrahlung effects. This modification is necessary for the discussion of cosmic-ray showers and bursts in elements of high atomic number since, for such elements, there is a region of energy in which the pair-production process is important while the cross-section usually assumed for the process is greatly in error. The maximum number of particles occurs at a distance slightly less for lead than for air, and for large distances the effect of the variation with energy of the pair-production cross-section is to increase the number of particles and γ-rays to be expected. Author.

2596. Heavy particles in cosmic rays. A. Widhalm. *Z. Phys.*, **115**, 7–8, *pp.* 481–496, 1940. *In German.*—Heavy particles in cosmic rays are investigated by photographic plates in 6 altitudes. The number of individual traces is increasing with the altitude to such an extent that an unusually high absorption coefficient results of 0·12 or 0·13 cm.$^{-1}$ Hg. The density of grains is compared with that produced by protons which are started by Be neutrons from paraffin. The result is that both the individual tracks and the star tracks are largely produced by protons and only to a very small extent by α-particles. In lower altitudes the energy spectrum is slightly shifted to particles of lower energy. No preferred direction of incidence can be observed. It is concluded that the individual proton tracks result from disintegration processes outside the photographic emulsion. O. O.

2597. Nuclear disruptions and heavy particles in cosmic radiation. I. Heavy particles in cosmic radiations as the result of nuclear disruptions. II. The collision and the evaporation process. E. Bagge. *Ann. Phys., Lpz.*, **39**, 6–7, *pp.* 512–552, 1941. *In German.*—In view of the close resemblance between the variation with height in the atmosphere of the frequencies of the proton tracks and the large bursts and electron showers, it is concluded that the nuclear disruptions are due to particles of the soft components of cosmic radiation. On this assumption the average energy of the primary particles must exceed 10^{10} eV. The presence of single heavy nuclear particles is considered a necessary consequence of the disruption processes, to which also the observed track frequencies can be quantitatively traced, within measurement uncertainties. The energy spectrum of the proton tracks resulting from the observations on nuclear disruptions is derived and is compared with the measurements. The collision and the evaporation processes in nuclear disruptions are discussed. The frequency distribution of the total energies imparted to the nuclear bricks in the collision process is calculated on the assumption that in the primary act a strong impulse is given only to a single nuclear particle which subsequently collides with the other nuclear components. The energy distribution thus determined cannot, however, be brought into agreement with that obtained experimentally. It must, therefore, be concluded that in the primary act several, in many cases at least 3, heavy nuclear particles are hit. Finally, a formula for the velocity distribution of the ejected evaporated protons and neutrons is derived. It takes into account the cooling effect of the nuclear and the emission process. A comparison of this distribution function with experience shows that, in the evaporation process similar to U fission, the nuclear fragments must be larger than those found by earlier observers. H. G. S.

See also Abstract 2493.

FLUORESCENCE & PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

2598. Experiments on fluorescence radiation of helium and the conservation of the spin at impacts of the second kind between excited and normal helium atoms. R. Wolf and W. Maurer. *Z. Phys.*, **115**, 7–8, *pp.* 410–430, 1940. *In German.*—Fluorescence experiments with normal He atoms are described. Only the principal series of the singlet system is observed, at least at low pressure, as expected on the basis of the selection rules. With increasing He more singlet and triplet lines are observed. It is shown that in certain impacts the total electron spin of both partners changes by $h/2\pi$. According to Wigner's law of the conservation of the spin such impacts should be forbidden. O. O.

2599. Phosphorescence and its applications. J. N. Bowtell and E. E. Miles. *G.E.C. J.*, **11**, *pp.* 256–265, *Aug.*, 1941.—After a brief historical résumé of the subject the authors give an account of the properties of both phosphorescent and fluorescent materials and of the theory which has been put forward to explain the mechanism of photo-luminescence. In considering the applications of luminescent materials to practical problems the authors deal with both types of material and their different brightness-decay curves, mentioning the various forms in which the materials are available and giving directions for applying the materials as paint. J. W. T. W.

See also Abstracts 2585, 2609.

INTERFERENCE, DIFFRACTION AND SCATTERING.

2600. Multi-pole nature of elementary sources of radiation—wide-angle interference. S. Freed and S. I. Weissman. *Phys. Rev.*, **60**, *pp.* 440–442, *Sept.* 15, 1941.—The fluorescence from ions of Eu in solution consisted of different kinds of radiation, possessing different interference properties. From the behaviour of the fringe systems 1 group of spectral lines was identified as arising from magnetic dipoles while 2 other groups had their origin in the forced oscillations of electric dipoles. The multi-pole character of the radiation of a quantum transition was found modified by a change in the microscopic fields about the emitting ions. Authors.

2601. Scattering of light by metal foils. E. David. *Z. Phys.*, **115**, 9–10, *pp.* 514–521, 1940. *In German.*—A light wave passing through a metal foil induced electric dipole moments in the individual grains of the foil. These moments are proportional to the volume of the grains. Since the optical constants of the foil are derived by the summation over the dipole moments, the individual volume cannot be derived from these constants. However, the intensity of the scattered light results from the summation over the squares of the dipole moments. Therefore, from this intensity the average volume of the individual grains can be determined. For 2 gold foils of a thickness of 3 $m\mu$ average grain volumes are derived as large as 1 000 $m\mu^3$. Such a large volume is interpreted, for example, by linear dimensions of 4 by 10 by 25 $m\mu$. O. O.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

2602. Physico-chemical properties and electrochemical reduction mechanism of the chromophore nitrosobenzene group. E. Hertel and F. Lebok. *Z. phys. Chem. B*, **47**, *pp.* 315–342, *Nov.*, 1940. *In German.*—The nitroso group is an independent chromophore and photochemically active. It is able to undergo a number of characteristic reactions and is strongly influenced by substituents in the benzene ring. Chromo-variability, electro-variability, basicity and reactivity with H atoms are discussed. The results of measurements by standard methods concerning absorption spectra, dipole moments and basicity, are given. For the reactivity measurements special methods were developed, based on cathodic reduction below the potential of H separation. The arrangement of, and apparatus for, these tests is described and illustrated. [See Abstr. 182 (1940)]. R. N.

2603. Mechanism of the photochemical change of acetylene. B. L. Dunicz. *J. Amer. Chem. Soc.*, **63**, *pp.* 2461–2472, *Sept.*, 1941.—C_2H_2 on irradiation with ultra-violet light below 2 350 Å decreases in pressure and gives as main products of polymerization a yellow powder precipitated from the gas phase and related to cuprene, and a small amount of C_6H_6. Intermediate products were traced by detailed absorption-spectra investigations under various conditions. It was shown that vinylacetylene is not the first step in the chain of polymerization, although it can be produced as a side product by keeping the pressure very low during irradiation. It may arise from an unstable dimer cyclobutadiene. Intermediate trimers characterized by their absorption spectra may be acetylenecyclobutenes, very reactive in both isomeric forms. Mechanisms are discussed in detail. It is reasonable to assume that in each cycle an inactive aromatic isomer is formed, just as C_6H_6 is formed in the first cycle, so that some of the chains do not proceed any further. The average chain length depends on the relative probability of formation of these inactive compounds. N. M. B.

2604. Number of quanta required to form the photographic latent image as determined from mathematical analysis of the *H* and *D* curve. II. J. H. Webb. *J. Opt. Soc. Amer.*, **31,** *pp.* 559–569, *Sept.*, 1941.—Analytical methods are substituted for the graphical procedure previously reported [Abstr. 1799 (1941)], and the theoretical curves obtained from the equations derived are compared with observed data for 3 widely differing types of emulsions. Good agreement is obtained. N. M. B.

2605. The photo-decomposition of gaseous acetone. II. R. Spence and W. Wild. *J. Chem. Soc.*, *pp.* 590–596, *Sept.*, 1941.—It has been shown that the apparently contradictory results of Herr and Noyes [Abstr. 2785 (1940)] and of Spence and Wild [Abstr. 2556 (1937)] on the photo-decomposition of gaseous acetone in the continuum region of absorption can be represented by a single expression derived from a common mechanism. Attention has been directed to a number of interesting facts relating to the photo-decomposition in the banded region of absorption which are inexplicable on the basis of a purely radical type of mechanism. A theory which postulates 2 activated states of the acetone molecules, one of which has a life period of the order of 10^{-5} sec. and the other of which is a metastable state of long life (10^{-2} sec.), has been advanced in order to account for these results. Authors.

2606. The polymerization of olefines induced by free radicals. C. J. Danby and C. N. Hinshelwood. *Proc. Roy. Soc. A*, **179,** *pp.* 169–193, *Oct.* 10, 1941.—The rate of photolysis of the simple aldehydes at 300° is in general reduced by ethylene, propylene or iso-butylene, and many molecules of the olefine may undergo an induced polymerization for each quantum of light absorbed by the aldehyde. A similar polymerization is induced by photolysis of ketones. The kinetics of these interdependent processes have been investigated by combining pressure measurements with chemical analysis at each stage, the rates of olefine polymerization and of aldehyde photolysis being independently determined.

Authors.

2607. Bromine-sensitized photochemical oxidation of chloral. J. Stauff and H. J. Schumacher. *Z. phys. Chem. B*, **48,** *pp.* 154–175, *Jan.*, 1941. *In German.*—A similar chain reaction is found as with Cl-sensitized oxidation [Abstr. 440 (1940)], the principal difference being the formation of H_2O as one of the reaction products. This is explained by the fact that one of the partial reactions with HBr is exothermic while the corresponding reaction with HCl is endothermic. The quantum yield is 8 molecules/$h\nu$ at 90°, 100 mm. Hg, each of chloral, B and O and a light absorption of $3{\cdot}3 \times 10^{13}$ $h\nu$/cm.^{3} The partial reactions and the reaction speeds are discussed. The temperature coefficient is 1·3 per 10 deg. temperature rise, corresponding to an apparent activation energy of 6·5 k. cal. The activation energies of some of the partial reactions are estimated. R. N.

2608. Studies on the characteristic curve of photographic papers. F. Urbach and A. Urbach. *J. Opt. Soc. Amer.*, **31,** *pp.* 581–587, *Sept.*, 1941,—A theoretical treatment in which certain factors are introduced which are often ignored, thus interreflections (important if there is optical contact between the emulsion layer and the reflecting paper) are allowed for. Measurements are given which justify the inclusion of this factor. The various attempts which have been made to define a measure for paper contrast are discussed and certain suggestions are made. A. H.

2609. Photography by luminescent screens in the extreme ultra-violet. T. Suga and M. Kamiyama. *J. Opt. Soc. Amer.*, **31,** *pp.* 592–593, *Sept.*, 1941.—A vacuum spectrograph with a 1 m. concave grating at grazing incidence was used to measure the response characteristics of various fluorescent materials. Author.

2610. The distribution of the latent image in the silver bromide grain. G. Kornfeld. *Commun. No.* 814 *Kodak Res. Lab.* *J. Opt. Soc. Amer.*, **31,** *pp.* 598–601, *Sept.*, 1941.—In 3 different commercial emulsions the distribution of the latent image between the surface and the interior of the silver bromide grains was investigated. The results show the sensitivity centres to be almost exclusively on the surface of the grains. Competitive centres are formed in the interior by strong exposures. Author.

2611. Adsorption in photographic development. I. On the non-adsorption of organic developers to metallic silver. E. S. Perry, A. Ballard and S. E. Sheppard. *J. Amer. Chem. Soc.*, **63,**

pp. 2357–2361, *Sept.*, 1941.—A method is described for the determination of the adsorption of organic reducing substances to metallic (colloid) silver in an oxygen-free atmosphere. Under these conditions no adsorption of hydroquinone or of methyl-*p*-aminophenol was observed greater than accountable by the error of experiment, of the order of 0·3%. It is concluded that the evidence adduced by Rabinovitch in support of the hypothesis of adsorption to metallic silver is unreliable. Experiments under the same conditions with silver sulphide failed to show any adsorption of these developers. The bearing of the results on the theory of photographic development is discussed. Authors.

See also Abstract 2548.

PHOTOMETRY.

*__2612. Spectrophotometer for measurement of optical filters.__ S. W. Seeley and E. I. Anderson. *Rev. Sci. Instrum.*, **12,** *pp.* 392–395, *Aug.*, 1941.—In connection with television development it has been found necessary to make measurements on the spectral characteristics of optical filters. The conventional equipment usual for such purposes not being available, a c.r. oscilloscope is employed and gives highly satisfactory results with sufficient accuracy for many purposes. Considerations of design are discussed at length and full constructional details given. A. H.

POLARIZATION.

2613. Magnetic rotatory power of crystalline nickel sulphate in the ultra-violet region. J. J. O'Connor, C. Beck and N. Underwood. *Phys. Rev.*, **60,** *pp.* 443–447, *Sept.* 15, 1941.—Previous measurements of the magnetic rotatory power of crystalline $\alpha - \mathrm{NiSO_4{\cdot}6H_2O}$ in the visible region of the spectrum and at one point in the ultra-violet have been extended into the ultra-violet as far as the 0·2537μ line of Hg. An unsymmetrical anomaly has been found at the strong 0·3850μ absorption band. The constants in the equation for magnetic rotatory dispersion have been evaluated so that Verdet constants calculated from the equation agree with the experimental values throughout the visible and ultra-violet, except within the 0·3850μ absorption band. [See Abstr. 2437 (1940)]. Authors.

See also Abstract 2544.

REFLECTION, REFRACTION AND DISPERSION.

2614. Unit planes of a plane-parallel plate. A. J. Kavanagh. *J. Opt. Soc. Amer.*, **31,** *pp.* 602–603, *Sept.*, 1941.—[See Abstr. 1566 (1941)].

2615. The string model in geometrical optics. L. E. Dodd and C. P. Wiedow. *Amer. J. Phys.*, **9,** *pp.* 102–106, *April*, 1941.

*__2616. An achromatic reflection microscope for use with visible or ultra-violet light.__ B. K. Johnson. *Proc. Phys. Soc., Lond.*, **53,** *pp.* 714–718; *Disc.*, 718–719, *Nov.*, 1941.—This paper describes the performance of an achromatized optical system for a microscope, for use over a wide range of wavelengths either in the visible or ultra-violet spectrum, which arises from the continuation of a design initiated in 1934. An aluminized parabolic mirror and a LiF. SiO$_2$ objective are employed, and the calculated aberration values are given. Photomicrographs taken with the complete instrument (unpublished) are available. Author.

See also Abstract 2715.

SPECTROSCOPY.

2617. Rapid spectrochemical analysis of steel in large American plants. H. Kaiser. *Z. Ver. dtsch. Ing.*, **85,** *pp.* 40–43, *Jan.* 11, 1941. *In German.*—In a report on Sawyer and Vincent's method [Abstr. 2141 (1937) and 2797 (1940)] the author discusses the significance of some of the measures taken, from the physical and the technical points of view. A Bibliography of 17 publications is given. R. N.

2618. On the effect of mercury vapour on the continuous spectrum of hydrogen excited by canal rays of hydrogen. V. T. Chiplonkar. *Indian J. Phys.*, **15,** *pp.* 53–57, *Feb.*, 1941.—It is shown that the presence of Hg vapour in the discharge tube brings about a marked change in the relative intensity distribution of the continuous spectrum of H, as excited by canal rays of hydrogen, in the observation chamber of a canal-ray tube in its simple form. The effect is found to be more pronounced at higher operating voltages than at low. The bearing of this result on the known observations on the excitation of the continuous spectrum by canal rays is pointed out; a discussion is given of the possible explanations for the change brought about by the presence of Hg vapour. Author.

2619. Hyperfine structure in the arc spectrum of Sn. S. Tolansky and G. O. Forester. *Phil. Mag.*, **32,** *pp.* 315–323, *Oct.*, 1941.—Hyperfine-structure measurements are made on lines of the Sn arc spectrum, most of which lie in the ultra-violet region. It is confirmed that the 2 odd isotopes 117, 119, have nuclear spins of $\frac{1}{2}$ and identical nuclear magnetic moments. No even isotope displacements are observed, and from observations upon reversals it is shown that any existing even isotope displacements must be very small. The classified lines amongst those observed are analysed, and hyperfine structure interval factors are derived for 7 terms. Amongst these are the complete group belonging to the deep $5p^3$ electron configuration. The nuclear coupling of the $5p^3$ electron group is shown to be large, in agreement with deductions about the nuclear coupling of the $5p^4$ electron group in I. A J-value has been allocated to one term on the basis of hyperfine-structure evidence. AUTHORS.

2620. The broadening of spectral lines treated on the basis of the collision theory and the statistical theory. G. BURKHARDT. *Z. Phys.*, **115**, 9–10, *pp.* 592–624, 1940. *In German.*—By a simple method the co-operation of both theories mentioned is discussed. The numerical values of the constants of the first member of the van der Waals force C/r^6 are computed and the higher members estimated. O. O.

2621. Temperature classification of thulium lines. A. S. KING. *Astrophys. J.*, **94**, *pp.* 226–231, *Sept.*, 1941.—The spectrum of Tm has been examined at different temperatures of the electric furnace. With the aid of unpublished wavelengths and arc intensities supplied by Meggers, 357 lines of Tm I and Tm II from λ 3 081 to λ 8 018 have been classified according to their response to temperature excitations from 2 000° to 2 600°C. Pending the definite establishment of energy-levels, lines judged to be from low levels in both the neutral and singly ionized spectra are suggested as identifications of faint lines in the solar spectrum. AUTHOR.

2622. The behaviour of visual purple at low temperature. E. E. BRODA AND C. F. GOODEVE. *Proc. Roy. Soc. A*, **179**, *pp.* 151–159, *Oct.* 10, 1941. —Visual purple is soluble and stable in a mixture of glycerol and water (3 : 1). At room temperature the spectrum of such a solution is identical with that of the aqueous solution. At — 73°C. the peak of the absorption curve is higher and narrower than at room temperature, and it is shifted towards longer waves. The product of photo-decomposition at — 73°C. has a spectrum independent of pH and is at low temperatures thermostable and photostable, but at room temperature it decomposes thermally to indicator yellow. The primary product appears to be identical with transient orange. The quantum yields of the photoreaction at low and at room temperature are of the same order. AUTHORS.

2623. The band spectrum of thallium bromide. H. G. HOWELL AND N. COULSON. *Proc. Phys. Soc., Lond.*, **53**, *pp.* 706–713, *Nov.*, 1941.—The spectrum TlBr has been photographed in absorption and in emission from 3 400 to 4 500 Å. A very small but intense band system occurs, in emission only, at 3 950 Å. The lower state of this system is the upper state of the main system. Predissociation occurs in both systems, and the unstable levels responsible are the upper levels of continua at 1 900 and 3 300 Å. Other continua occur at 2 700 and 2 960 Å. AUTHORS.

2624. The absorption spectra of the cyclic dienes in the vacuum ultra-violet. W. C. PRICE AND A. D. WALSH. *Proc. Roy. Soc. A*, **179**, *pp.* 201–214, *Oct.* 10, 1941.—The absorption spectra of cyclohexadiene, cyclopentadiene, pyrrole, thiophene and furan have been investigated in the vacuum ultra-violet. The spectra obtained are due to the excitation of a π electron from the conjugated double-bond electrons ($\chi_1^2\chi_2^2$). The ionization potentials of the molecules deduced from Rydberg series are respectively 8·4, 8·58, 8·9, 8·91 and 9·01V, these values referring to the outer χ_2 shell of π electrons. A second, less certain, ionization potential of about 10·8 V was obtained for furan. Some discussion of the electronic structure of the molecules on the basis of their spectra is given, and it is concluded that only in furan is there marked tendency towards homocyclic conjugation. It is also concluded that hyperconjugation does not play so large a part in the interpretation of the spectra of cyclohexadiene and cyclopentadiene as previously supposed. AUTHORS.

2625. Structure of the electronic bands of the OD molecule. I. M. G. SASTRY AND K. R. RAO. *Indian J. Phys.*, **15**, *pp.* 27–51, *Feb.*, 1941.—Bands due to the OD molecule have been obtained, free from any trace of the OH bands, by photographing discharges through vapour of heavy water of a very high degree of purity. Measurements on the plate between λ2 800 and λ3 060 have led to the rotational structure of the (1, 0), (2, 1) and (3, 2) bands. Using Hill and van Vleck's energy formula for the doublet electronic states the rotational constants have been evaluated. The calculated positions of the null lines have made possible the determination of the vibrational constants of the OD molecule and the mass-ratio of the hydrogen isotopes. AUTHORS.

2626. Rotational analysis of γ-system of ZrO bands. T. TANAKA AND T. HORIE. *Proc. Phys.-Math. Soc., Japan*, **23**, *pp.* 464–484, *June*, 1941.—A rotational analysis is performed for the ZrO γ-system of bands, the spectrograms used being obtained in the 3rd order of a 21 ft. grating. The system is considered to be a $^3\Sigma \rightarrow {}^3\Pi$ transition, the final state being the same as that of the α-system. The following constants are obtained : $B_e'=0{\cdot}5658$ cm.$^{-1}$, $\alpha'=0{\cdot}0077$, $r_e'=1{\cdot}477\times10^{-8}$cm, $B_e''=0{\cdot}6189$ cm.$^{-1}$, $\alpha''=0{\cdot}0038$, $r_e''=1{\cdot}412\times10^{-8}$cm. The trebling of the levels of the $^3\Sigma$ state is not observed but the Λ-type separations for the $^3\Pi$ state are determined. The isotope effect is discussed. A. H.

2627. Studies on the near ultra-violet absorption spectra of benzene and its derivatives. III. Phenol.

K. ASAGOE, Y. SHIMOKAWA AND S. KAGEYAMA. *Jap. J. Phys.*, **14**, 1, *pp.* 11–16, 1940–1941.—A study is made of the ultra-violet absorption spectrum of phenol, a Hilger E1 spectrograph and H discharge tube being used. A vibrational analysis of the spectrum is made, the bands being classified into 5 series exhibiting constant differences of 473, 779, 932, 982 and 1 272 cm.$^{-1}$. A. H.

2628. Assignment of electronic bands in spectra of solutions. IV. G. KORTÜM AND B. FINKH. *Z. phys. Chem. B*, **48**, *pp.* 32–49, *Nov.*, 1940. *In German.*—[See Abstr. 4055 (1939)]. The light absorption of a number of simple N-O acids and their salts is investigated in order to show that observed electronic bands may be assigned to well defined chromophores; also in mesomeric systems with conjugated double bonds. The part played by different electromeric boundary structures for the stable state of molecules is discussed. For some cases the position of tautomeric equilibria may be determined from the spectra. R. N.

2629. Analysis of the (0, 3) band of the first negative system of the O_2^+ molecule. T. E. NEVIN AND T. MURPHY. *Proc. Roy. Irish Acad. A*, **46**, *pp.* 169–181, *March*, 1941.—The (0, 3) band of the first negative system of O_2^+, due to the transition ${}^4\Sigma_g^- \rightarrow {}^4\Pi_u$, is photographed in the second order of a 21 ft. grating using a hollow-cathode discharge. The analysis of the band is given and the constants of the final level $\nu'' = 3$ are calculated. A. H.

2630. Quadratic Zeeman effect of the lines of Eu sulphate. A. SCHMILLEN. *Ann. Phys., Lpz.*, **39**, 6–7, *pp.* 502–511, 1941. *In German.*—The paper comprises an investigation of the transverse Zeeman effect of a single crystal of Eu sulphate for different orientations and with polarized light. The lines of the blue and green absorption group corresponding to the transitions between the terms ${}^7F_0 - X_2$ and ${}^7F_0 - X_1$ give a Zeeman effect which increases quadratically with the magnetic field. The magnitude and direction of the effect are dependent only on the orientation of the magnetic field to the crystal, independent of the directions of the light and polarization. Conclusions regarding the directions of the oscillations of the absorbing dipoles are drawn from the intensities of the absorbing lines for different directions of the light and polarization. The absorption of the blue group is ascribed to electric dipoles oscillating, partly only in one single direction, and partly in the plane arbitrarily, in part also in every direction, whereas the magnetic dipoles of the group of green lines show only a slight preference for one direction. H. G. S.

2631. Raman spectra of some crystalline nitrates and sulphates. B. L. RAO. *Proc. Indian Acad. Sci. A*, **14**, *pp.* 48–55, *July*, 1941.—Using single crystals of Sr, Ba and Pb nitrates, several new l.f. lines have been recorded. The sulphates examined in the form of single crystals have yielded all the frequency shifts characteristic of the internal oscillations of the sulphate ion, including some of the split components of the degenerate lines and also some new lattice frequencies. The paramagnetic sulphates have been shown to behave exactly like the non-paramagnetic sulphates. The features exhibited by the water bands do not show any obvious correlation either with the number of molecules of the water of crystallization or the crystal structure of the solid. AUTHOR.

2632. Raman effect in potassium tartrate crystal. B. L. RAO. *Proc. Indian Acad. Sci. A*, **14**, *pp.* 41–42, *July*, 1941.

2633. Studies on the Raman effect. Rotational isomerism (alkylpolyhaloids). L. KAHOVEC AND J. WAGNER. *Z. phys. Chem. B*, **47**, *pp.* 48–54, *Aug.*, 1940. *In German.*—The Raman spectra of a number of alkylpolyhaloids were investigated, partly for the first time, partly as check on previous investigations [Abstr. 808 (1941)]. Rotational isomerism is proved by the increase of lines in the frequency range below 800 cm.$^{-1}$ for the transition from the rigid chain of 2,2 dihalogene-propane to the movable chains of 1,2 and 1,3 dihalogene-propane. A similar increase of lines is probable for the C-halogene valency frequency of 1,1,2 trihalogene-ethane. R. N.

2634. Studies on the Raman effect. Rotational isomerism (dihalogene-ethanes). K. W. F. KOHLRAUSCH AND H. WITTEK. **(Halogen-substituted butanes.)** L. KAHOVEC AND K. W. F. KOHLRAUSCH. *Z. phys. Chem. B*, **47**, *pp.* 55–65, *Aug.*, *and* **48**, *pp.* 7–11, *Nov.*, 1940. *In German.*—The total experimental material at present available concerning the oscillation spectra of dihalogene-ethanes is analysed. The assumed coexistence of *cis-* and *trans-*forms allows of explaining all peculiarities of the oscillation spectra observed with regard to chain frequencies and CH-frequencies.—Previous measurements are repeated and new measurements made. The Raman spectra of 1,2 dihalogen ethanes and their homologues are discussed. R. N.

2635. Studies on the Raman effect: tetrachloroethylene. H. WITTEK. *Z. phys. Chem. B*, **48**, *pp.* 1–6, *Nov.*, 1940. *In German.*—The Raman spectrum of C_2Cl_4 is determined with normal and large dispersion and the depolarization of the principal lines is measured and compared with the results of previous investigators. On the basis of the experimental results and of model calculations the 6 oscillation forms active in the Raman effect are co-ordinated with the frequencies observed. The change of frequency is given for the molecules $X_2C{:}CX_2$ with X=H, D, CH_3, Cl, Br. R. N.

2636. Studies on the Raman effect: cyclohexane and oxalyl chloride. K. W. F. Kohlrausch and H. Wittek. *Z. phys, Chem. B*, **48**; *pp*. 177–187, *March*, 1941. *In German.*—For the 2 substances the Raman spectra with large dispersion are determined and the polarization is measured. Only a non-plane form of the molecules appears to be compatible with the test results, contrary to the deductions of previous investigators [Abstr. 2159 (1940)]. Observations at present available are not sufficient to decide on the molecular form of oxalyl chloride. R. N.

2637. Studies on the Raman effect: chlorotrifluoromethane. L. Kahovec and J. Wagner. *Z. phys. Chem. B*, **48**, *pp*. 188–192, *March*, 1941. *In German.*—The Raman spectrum of liquefied $Cl{\cdot}CF_3$ is determined. By investigating the spectral transition $CF_4 \rightarrow Cl{\cdot}CF_3 \rightarrow Cl_2{\cdot}CF_2 \rightarrow Cl_3{\cdot}CF \rightarrow Cl_4F$ the state of polarization of the lines was determined indirectly. The direct measurement was not possible as the apparatus was unsuitable for the low temperatures required and the strongest Raman tube exploded under the pressure of the gas liquefied at room temperature. R. N.

2638. Studies on the Raman effect: carboxyl sulphide and cyanchloride. J. Wagner. *Z. phys. Chem. B*, **48**, *pp*. 309–315, *April*, 1941. *In German*—While hitherto the molecules of OCS and ClCN were supposed to have linear structure, the polarization state of the Raman spectra of the 2 substances tends to show that this holds true for the latter. The same result is obtained from the observation of the splitting of the lines in the presence of isotopes. The measurements are compared with those of previous investigators, and the infra-red spectrum of OCS is discussed. R. N.

2639. Studies on the Raman effect: quinuclidine. J. Wagner. *Z. phys. Chem. B*, **48**, *pp*. 316–320, *April*, 1941. *In German.*—The Raman spectra of quinuclidine ($C_7H_{13}N$) and bicyclo-(1,2,2)-aza-1-heptane ($C_6H_{11}N$), two bicyclic amines of high m.p. are discussed. A satisfactory description of the frequencies was not obtainable. R. N.

2640. Resonance and isotopic effects in the Raman spectrum of CS_2. L. Giulotto and P. Caldirola. *Z. phys. Chem. B*, **49**, *pp*. 34–42, *May*, 1941. *In German.*—A careful investigation of the Raman spectrum of CS_2 showed it composed of 2 bands, 1 with 2 principal components of the frequencies 653·5 and 645·2 cm.$^{-1}$ and the other with components of the frequencies 794·5 and 802·5 cm.$^{-1}$. These frequencies and the relative intensities of the components are in good agreement with Fermi's resonance theory [Abstr. 455 (1932)]. A third component in either band (frequencies 642 and 783 cm.$^{-1}$) is explained by the isotopic effect of S^{35}. A weak band of frequency 393 cm.$^{-1}$ is attributed to the forbidden natural vibration. R. N.

2641. Raman effect in relation to crystal structure: lattice oscillations. S. Bhagavantam. *Proc. Indian Acad. Sci. A*, **13**, *pp*. 543–563, *June*, 1941.—The view is advanced that there are no grounds for assuming that the l.f. lines occurring in the Raman spectra of crystals have an origin essentially different from that ascribed to the h.f. lines. They are all to be regarded as representatives of the various optical series into which the normal oscillations of a crystal may be divided. For convenience these are divided into 3 classes, the internal, the rotatory type of external, and the translatory type of external ones. Formulae useful for classifying the normal oscillations in the above manner are developed and applied to typical cases. Various aspects of interpretaion of the results are discussed at length. A. H.

2642. Raman spectrum of sulphur. K. Venkateswarlu. *Proc. Indian Acad. Sci. A*, **12**, *pp*. 453–461, *Nov.*, 1940.—A detailed investigation of the Raman spectrum of a single crystal of rhombic S is made. Nine frequencies ranging from 84 to 520 cm.$^{-1}$ are recorded, 2 (84 and 115) being attributed to the lattice whilst the remainder are taken as the fundamentals appropriate to the S_8 molecule. A detailed scheme showing the selection rules for the occurrence of overtones and combinations is given. The spectrum is studied at 30°C. and 150°C. but no change, either in the relative intensities or in the position of the lines, is observed. The effect of crystal orientation on the Raman spectrum is also studied. A. H.

TRANSMISSION.

2643. A new way of measuring the velocity of light. R. A. Houstoun. *Proc. Roy. Soc. Edinb.*, **61**, 1, *pp*. 102–114, 1941.—A rectangular piece of quartz placed in a periodic electric field becomes an intermittent diffraction grating through the action of the ultrasonic waves formed in it. This occurs when the quartz is in resonance with the field. A beam of light is passed through the quartz at rt. angles to the direction of the electric field and one of the diffracted beams is reflected back along its path through the crystal. If the beam on its return to the quartz arrives when the grating is in action, the diffraction pattern passes on to the source, but if the atoms of the quartz are in their mean positions, there is no diffraction. This property gives a method of measuring the velocity of light by altering the distance of the reflecting mirror from the quartz. An electrical field of 100 Mc./s. gave the best results. The method is better suited to measuring secular changes in the velocity of light, or the variation of velocity with wavelength in a short path, than to an abs. determination. G. C. McV.

VISION.

2644. Physiology of colour vision. G. von Studnitz. *Naturwissenschaften*, **29**, *pp.* 377–389, *June* 27, 1941. *In German.*—The paper discusses colour vision theory, in particular the 3-components theory, and examines the physiological data in its support. An extensive review of the literature is given. The data considered include the sensation curves, complementary colours, simultaneous and successive contrast, retinal interaction, electro-retinograms and the absorption curves of substances extracted from the eye of the snake. W. D. W.

2645. The variation in visual acuity with fixation-distance. M. Luckiesh and F. K. Moss. *J. Opt. Soc. Amer.*, **31**, *pp.* 594–595, *Sept.*, 1941.

2646. The refraction of various spectral qualities of light by the human eye. M. Luckiesh and F. K. Moss. *J. Opt. Soc. Amer.*, **31**, *pp.* 595–597, *Sept.*, 1941.

2647. The retinal mechanism of colour reception. R. Granit. *J. Opt. Soc. Amer.*, **31**, *pp.* 570–580, *Sept.*, 1941.—This paper is a review of the analysis of colour reception with the aid of electrophysiological methods, Micro-electrodes have been inserted into the retina to record the discharge of impulses from single or a restricted number of elements in response to illumination with a spectrum of known energy distribution. From the electrodes leads have been taken to amplifier, cathode ray and loud-speaker. In this manner it has been possible to obtain curves showing the distribution of sensitivity to spectral light of active elements in the eyes of mammals, amphibians and fishes. Young's conception, that the retina possesses elements sensitive to different regions of the spectrum, has been proved to be correct. A number of other results illustrate some fundamental properties of the mechanism of colour reception. Author.

See also Abstract 2576.

X-RAYS.

2648. The 2 types of X-ray reflection in crystals. C. V. Raman and N. S. N. Nath. *Proc. Indian Acad. Sci. A*, **12**, *pp.* 427–439, *Nov.*, 1940.—Anomalous reflections from crystals are explained as being due to inelas[illegible] collisions of photons in which the photon excites the vibration of the crystal lattice and is itself reflected by the resulting dynamic stratifications of electron density. The intensity of this "modified" reflection is considered briefly, together with the influence of temperature and other factors. J. T.

2649. Non-Laue maxima in the diffraction of X-rays from rocksalt. Temperature effect. O. J. Baltzer. *Phys. Rev.*, **60**, *pp.* 460–465, *Sept.* 15, 1941.—An ionization chamber and electrometer tube circuit were used in determining the intensity of the non-Laue max. observed when Cu $K\alpha$ X-rays are diffracted from a rocksalt crystal. Measurements were made at room temperature and at liquid-air temperature for the 200-, 400-, and 600-regions of scattering. It is found that the experimental decrease in intensity at liquid-aid temperature is in fair agreement with an expression of the form $(1 - e^{-2M})$, where e^{-2M} is the well-known Debye-Waller temperature factor. Author.

2650. Directional distribution of X-ray intensity from anti-cathodes. H. Hinz. *Ann. Phys., Lpz.*, **39**, 8, *pp.* 573–590, 1941. *In German.*—The paper comprises an investigation at 150-300 kV of the intensity distribution of X-rays from massive anti-cathodes—Be, selected owing to the electron diffusion being the least marked among the light elements; Al, Cu and Ag, for testing dependence of the intensity on the ordinal number; and Pb, for technical reasons. With Be, tests are conducted up to a voltage at which the intensity max. can be separated, and the intensity ratio I_0/I_{90} is determined for the radiation directions $\delta = 0°$ and $\delta = 90°$ as a function of voltage and filtering. I_0/I_{90} is determined at uniform voltage (250 kV) and filtering (0·7 mm. Pb) for Be, and also for Al, Cu and Ag. In addition, a few observations with Pb are added for larger filter thicknesses. The results obtained are as follows:—By increasing the filtering the position of the intensity max. can be investigated up to 250 kV with Be. At this voltage the observed value is about 9° smaller than would be expected from the Sommerfeld theory. The reason is to be sought in the effect of the diffusion of the cathode rays and the superposition of the different portions of the X-ray cone. The difference in the intensity of the radiation for $\delta = 0°$ and $\delta = 90°$ grows with increasing filtering and rising voltage in the case of Be. I_0/I_{90} drops with increasing ordinal number (for Be, Al, Cu and Ag) for the same tube voltage and filtering. With Pb, I_0/I_{90}, for the same voltage and filtering as with Al, Cu and Ag, remains distinctly higher, and even here, with a large filtering increase, the intensity difference becomes more marked. Above about 300 kV it is advantageous, even with heavier anti-cathodes, for the X-ray window to be in the direction of the incident cathode rays. H. G. S.

2651. Significance of X-ray diffraction patterns obtained from starch granules. R. S. Bear and D. French. *J. Amer. Chem. Soc.*, **63**, *pp.* 2298–2305, *Sept.*, 1941.—By careful investigation of representative starch granule diffraction patterns, using moistened samples and a well collimated beam of monochromatic X-radiation, accurate measurements of resolved diffraction rings have been obtained. Evidence indicates that the diffractions are those of a single major component of the starch granules, and that there is ring-for-ring correspondence between the extreme (A and B) types of pattern. From analysis of potato (B) patterns it is possible to set up a unit cell and arrive at indices of planes responsible for the individual diffractions. These assignments can be carried over to the corn (A) starch patterns with comparatively slight changes in unit cell dimensions and angles, thus providing confirmation. The number of maltose residues per cell seems to be 2. Starch granule crystallites are apparently built on triclinic lattices whose axes are, however, very nearly orthogonal. AUTHORS.

2652. The interference counter as a tool for the investigation of the fine structure of X-ray spectra. R. LINDEMANN AND A. TROST. *Z. Phys.*, **115**, 7–8, *pp.* 456–468, 1940. *In German.*—The counter with the addition of vapours can be used for the investigation of fine structures. The arrangement is described. Examples are given for the resolving power and the speed of the measurements. O. O.

2653. Precision measurements of lattice constants by a compensation method. II. H. VAN BERGEN. *Ann. Phys., Lpz.*, **39**, 8, *pp.* 553–572, 1941. *In German.*—Precision measurements are made with crystals of $CaCO_3$, NaCl, Al and Fe using the compensation method [Abstr. 3717 (1936)]. The application of the method to hexagonal, tetragonal and rhombic systems is detailed. The calculation is carried out for $CaCO_3$ as an example of the hexagonal system, and for Fe for an asymmetric coincidence in the cubic system. The lattice constants at 20°C. are: $CaCO_3$, $a=9\,959{\cdot}93\pm0{\cdot}05$ XE, $c=8\,513{\cdot}06\pm0{\cdot}06$ XE, from which $d=3\,029{\cdot}45\pm0{\cdot}02$ XE at 18°C. is calculated; NaCl, $a_w=5\,628{\cdot}69\pm0{\cdot}06$ XE; Al, $a_w=4\,040{\cdot}91\pm0{\cdot}06$ XE; Fe, $a_w=2\,860{\cdot}75\pm0{\cdot}02$ XE. A discussion of the possible errors shows that the systematic errors are substantially below the statistical variations of the results. The cause of these variations, besides faulty crystal structure, must be ascribed to the natural breadth of the X-ray emission lines, which sets a limit to the accuracy of measurement. With the perfect crystals of $CaCO_3$ and Fe this lower limit can be reached. A comparison with the measurements of other investigators gives agreement within the error limits. The discrepancies respecting NaCl and Fe are probably traceable to the diversity of the material used. [See Abstr. 510 (1939)]. H. G. S.

2654. A laboratory course in X-rays. P. KIRKPATRICK. *Amer. J. Phys.*, **9**, *pp.* 14–21, *Feb.*, 1941.

HEAT.

CALORIMETRY.

2655. Heat capacity of gaseous paraffin hydrocarbons, including experimental values for *n*-pentane and 2,2-dimethylbutane. K. S. PITZER. *J. Amer. Chem. Soc.*, **63**, *pp.* 2413–2418, *Sept.*, 1941.

2656. Heat capacity and entropy, heats of fusion and vaporization and the vapour pressure, of silicon tetramethyl. J. G. ASTON, R. M. KENNEDY AND G. H. MESSERLY. *J. Amer. Chem. Soc.*, **63**, *pp.* 2343–2348, *Sept.*, 1941.

2657. Specific heat of calcium carbide at low temperatures. K. K. KELLEY. *Industr. Engng Chem.*, **33**, *pp.* 1314–1315, *Oct.*, 1941.

__2658. An apparatus for investigating the variable specific heat of carbon.__ E. FRANK. *Amer. J. Phys.*, **9**, *pp.* 227–228, *Aug.*, 1941.

2659. An experiment for the determination of work function through calorimetric measurements. P. L. COPELAND. *Amer. J. Phys.*, **9**, *pp.* 21–24, *Feb.*, 1941.—The paper suggests an experimental arrangement that may be used either to demonstrate the cooling effect of electron emission before a class or to facilitate a direct measurement of work function in the laboratory. Results are given for tungsten and for the oxide-coated cathodes in commercial radio tubes. H. H. HO.

2660. On the heat of sublimation of carbon and on some absorption bands of 3 mesomeric hydrocarbons. G. J. KYNCH AND W. G. PENNEY. *Proc. Roy. Soc. A*, **179**, *pp.* 214–231, *Oct.* 10, 1941. —Spectroscopic analysis of the CO spectrum, together with thermochemical measurements on the burning of C in O, lead to the conclusion that L, the heat of sublimation of carbon, is either 124 or 170 k.cal./mol. An estimate of L may be made by calculating the energies of excited states of benzene, butadiene and hexatriene, assuming various values of L, and choosing the one that gives the best agreement with experiment. Almost exact agreement with experiment is obtained in all 3 cases by assuming $L = 170$, and no agreement is obtained by assuming $L = 124$. The equilibrium internuclear distances in the excited states are found, and the potential function controlling some of the vibrations about these positions is determined. It is shown that the excited state of benzene has the regular hexagon configuration, the C-C internuclear distance being 1·45 Å, compared with 1·39 in the ground state. The carbon breathing frequency in the excited state is calculated to be 920 cm.$^{-1}$, compared with the experimental value 940 cm.$^{-1}$. AUTHORS.

See also Abstracts 2570, 2682, 2706.

CONDUCTION.

2661. On the problem of temperature distribution in plane plates. I. MALKIN. *J. Franklin Inst.*, **231,** *pp.* 129–150, *Aug.*, 1941.—An operational procedure is described for the determination of temperature distributions in plane plates in which the distribution varies with time, or, for the steady state, is characterized by considerable non-uniformity of the temperature gradient in the boundary surfaces. The only assumption made is that the temperature of the boundary surface is free from discontinuities along the main surfaces of the solid. The cases dealt with relate to a circular plane plate of comparatively small diameter. The methods are useful in connection with the calculation of thermal stresses in heated plates. R. W. P.

2662. The steady flow of heat from certain objects buried under flat air-cooled surfaces. F. H. SCHOFIELD. *Phil. Mag.*, **32,** *p.* 437, *Nov.*, 1941.—Erratum to Abstr. 1322 (1941).

2663. Heat conduction in composite circular cylinders. J. C. JAEGER. *Phil. Mag.*, **32,** *pp.* 324–335, *Oct.*, 1941.—The method of the Laplace transformation is used to give the temperature distributions in circular cylinders composed of 2 concentric materials, for various boundary conditions. R. W. P.

2664. On the propagation of a thermic disturbance. B. BAULE. *Z. phys. Chem. B*, **49,** *pp.* 102–106, *May*, 1941. *In German.*—Frey's paper [Abstr. 2689 (1941)] gives rise to the question of how the heat set free with condensation flows from the droplet to its surroundings. The equation for heat conduction in this case is derived. The thermic disturbance is propagated with decreasing speed and rapidly sinking intensity. The speed varies inversely as the distance of travel, the intensity inversely as (distance)^3. The time for the disturbance to reach a certain point is proportional to the square of its distance from the origin of the disturbance. R. N.

2665. Heat and vapour transfer in a wetted-wall tower. W. I. BARNET AND K. A. KOBE. *Industr. Engng Chem.*, **33,** *pp.* 436–442, *April*, 1941.—Heat and vapour transfer data were obtained from the operation of a wetted-wall tower with counter-current flow of liquid and air. Three series of runs were made with different liquids—2 with light paraffin-base oils to obtain data on heat transfer from gas to liquid without simultaneous vapour transfer, and the third series with water so that a study might be made of simultaneous heat and vapour transfer. In all cases the gas film was found to control the rate of heat transfer. AUTHORS.

2666. Determination of unit conductances for heat and mass transfer by the transient method. A. L. LONDON, H. B. NOTTAGE AND L. M. K. BOELTER. *Industr. Engng Chem.*, **33,** *pp.* 467–473, *April*, 1941.—A method is described, which utilizes the transient temperature behaviour of a thermal capacitor discharging into a fluid stream, for the determination of the unit conductances for mass and heat transfer. This method yields magnitudes which are in substantial agreement with those obtained by means of the orthodox steady-state procedure. A rate equation for energy transfer, combining the mechanisms of heat and mass transfer, is employed in the analysis. The relations between the unit conductances for mass transfer, heat transfer and energy transfer, by the combined mechanisms are considered. The accuracy of the transient method and the magnitude of the errors are discussed. The transient method appears to be sufficiently convenient and accurate so that a future programme contemplates an extension of its use to a number of heat and mass transfer problems. AUTHORS.

2667. Mean temperature difference in unbalanced-pass exchangers. K. A. GARDNER. *Industr. Engng Chem.*, **33,** *pp.* 1215–1223, *Oct.*, 1941.—The mean temperature difference in multi-pass heat exchangers with unequal tube passes may be calculated from the logarithmic mean temperature difference and the correction factors presented in this paper. The derivation of equations for exchangers with single-pass shells and any even number of tube passes is given in detail, and the method for extension to any number of shell passes is described. The equations of previous investigators appear as special cases of the author's general equations. The results are based on the usual assumptions and are presented in terms of the customary parameters plus an additional parameter involving the ratio of unbalance of the surfaces and rates in the counter-flow and parallel-flow tube passes. A discussion of the advantages and limitations of unbalanced-pass heat exchangers is included and examples are given. An additional use of the data as an approx. correction to mean temperature difference for variation of heat transfer rate in conventional multi-pass exchangers is suggested. AUTHOR.

See also Abstracts 2511, 2706.

CONVECTION.

2668. Propagation of temperature changes through textiles in humid atmospheres. IV. Extended theory. H. E. Daniels. **V. Comparison of different textile fibres.** S. Baxter and A. B. D. Cassie. *Trans. Faraday Soc.*, **37,** *pp.* 506–525, *Oct.*, 1941.—The theory of heat and water-vapour transfer through textiles is given when both diffusion and air transport are considered, and the shape of the experimental curves obtained [Abstr. 1204 (1940)] is adequately explained. A method is given for estimating the speeds of the fast and slow components by areas without detailed fitting of the theoretical curves. —The rates of propagation through similar samples of different fibres under identical experimental conditions are obtained. The results show that the time for the propagation of a given temperature change depends directly on the steepness of the regain-R.H. curve of the textile fibre used. Mean times, obtained from the experimental curves, are compared with theoretical values. Authors.

See also Abstract 2594.

DILATATION.

2669. The thermal expansion of lead from 0°C. to 320°C. A. R. Stokes and A. J. C. Wilson. *Proc. Phys. Soc., Lond.*, **53,** *pp.* 658–662, *Nov.*, 1941.—The variation with temperature of the lattice parameter of Pb has been measured and the coefficient of expansion deduced. The results are expressed by the equations: $d = 4{\cdot}936\,87 + 138{\cdot}98 \times 10^{-6}{\cdot}t + 60{\cdot}16 \times 10^{-9}t^2$Å, $a = 28{\cdot}15 \times 10^{-6} + 23{\cdot}6 \times 10^{-9}{\cdot}t$. The error in d is about 0·0001 Å, and in a $0{\cdot}3 \times 10^{-6}$. Authors.

2670. Thermal expansion studies of boric oxide glass and of crystalline boric oxide. J. J. Donoghue and D. Hubbard. *Bur. Stand. J. Res., Wash.*, **27,** *pp.* 371–379, *Oct.*, 1941.—The expansion characteristics of B_2O_3 glass and of a sample of crystalline B_2O_3 have been studied by the interferometer method. The results obtained are chiefly of qualitative interest but offer a satisfactory picture of some of the difficulties that must be overcome if true expansion data are to be obtained on these materials. The characteristics of the expansion curves are very different. The sample of B_2O_3 had a m.p. between 450° and 451°C. Upon being heated to its m.p. this material does not recrystallize on cooling, but remains in a fused state, as indicated by the critical and softening temperatures shown by its expansion curve. Authors.

2671. Thermal stresses in long cylindrical bodies. B. E. Gatewood. *Phil. Mag.*, **32,** *pp.* 282–301, *Oct.*, 1941.—The problem of finding thermal stresses and displacements in long cylinders is reduced to obtaining a particular integral for the Poisson equation $\Delta^2 V = kT$, where T is the temperature distribution and k is a constant, and to solving the biharmonic equation $\Delta^4 U = 0$ when the first derivatives of the function U are known on the boundary of the cross-section of the body. These 2 differential equations are related by the conditions that on the boundary the first derivatives of U are given in terms of the first derivatives of V. The biharmonic equation is solved by use of 2 analytic functions. The region within which the solution is desired is mapped conformally on the unit circle by a rational function, and from the boundary values on the unit circle the required analytic functions are determined directly by the use of the Cauchy integral formula. The methods are extended to multi-connected bodies and to bodies composed of several different materials. Special problems of the circular cylinder, the hollow circular cylinder, the concentric and eccentric composite circular cylinders, are solved. Author.

See also Abstract 2679.

FUSION AND SOLIDIFICATION.

2672. Is the precision of definition of the melting point affected by isotopy? K. Clusius and L. Staveley. *Z. phys. Chem. B*, **49,** *pp*, 1–12, *May*, 1941. *In German*—The precision of the m.p. is defined by the quotient $T_s/\Delta T$ where T_s is the m.p. and ΔT the lowering of the f.p. or, with mixed crystals, the melting interval. The investigations were carried out with CO, A, N_2O as pure substances or compounds and with HCl and HBr as isotopic compounds. A difference in the behaviour during melting was not found for these 2 groups. The triple-point pressure does not depend on the ratio between liquid and solid phase. A method based on melting for the separation of isotopes seems impossible. R. N.

2673. Cellulose and its derivatives as liquids with fixed structure. K. Ueberreiter. *Z. phys. Chem. B*, **48,** *pp.* 197–218, *March*, 1941. *In German.*—The trend of volume/temperature curves and the freezing phenomena of cellulose and its derivatives justify considering them as liquids with fixed structure as previously defined [Abstr. 839 (1941)]. The inner softening by nitration is discussed. Mobility is raised and the f.p. lowered by larger numbers of NO_2 groups replacing the OH groups. By adding solvents to the macromolecular substances outer softening takes place, causing a strongly concave trend of the f.p. curve. Swelling of the cellulose is dealt with as a special case. Mechanically shaped cellulose and polystyrol show similar behaviour with regard to the trend of their heating and cooling curves and to their sintering. R. N.

TEMPERATURE.

2674. Blocking-layer cell colour temperature pyrometer. J. T. M. MALPICA. *Gen. Elect. Rev.*, **44**, *pp.* 439–443, *Aug.*, 1941.—A radiation pyrometer has been developed for furnace temperatures, consisting of a blocking-layer photo-cell connected to a galvanometer. In the radiant beam may be placed either a red or a blue filter, and it is shown that the temperature may be calculated from the ratio of the readings, after initial calibration. An accuracy within 2 deg. at 1 500°K. is claimed. E. H. W. B.

2675. Measurement of flame gas temperatures. W. T. DAVID. *Engineer, Lond.*, **172**, *pp.* 186–187, *Sept.* 19, 1941.—Accurate values of CO-air flames temperature cannot be expected with the pyrometry methods generally used, and work is detailed in which a close approximation to the mean flame temperature may be made. Pt resistance thermometers are used with a coating of quartz on the hot-wire element. Results, when corrected for radiation loss, eliminate the errors due to the use of plain wires or inherent in other methods such as the Na line reversal method.

E. H. W. B.

THERMOCHEMISTRY.

2676. Theoretical calculations for explosives. F. W. BROWN. *Industr. Engng Chem.*, **33**, *pp.* 1181–1182, *Sept.*, 1941.—A convenient method of calculating approx. explosion temperatures and products of explosion for liquid and solid explosives is developed. The necessary thermodynamic data are assembled and extended. Calculations are made of explosion temperatures and products of explosion for several oxygen balances for a typical ammonium nitrate explosive and a typical 60% gelatin dynamite. AUTHOR.

2677. Concluding work on Cl detonation gas. M. BODENSTEIN. I. *S.B. Preuss. Akad. Wiss.*, *pp.* 2–18, 1936. II-III. *Z. phys. Chem. B*, **48**, *pp.* 239–288, *April*, 1941. *In German.*—A number of experimental treatises are collected with the common aim of elucidating the photochemical kinetics of the detonating gas reactions, especially the phenomena responsible for the termination of the chain. The results obtained by Norrish and Ritchie [Abstr. 3500 (1933)] concerning the photosynthesis of hydrogen chlorides are criticized. In Part I the course of the reaction with O-free gases was explained. Part II deals with the part played by the reaction $H + HCl = H_2 + Cl$ and is based on experimental work concerning the inhibiting effect of HCl and the termination of the chain by recombination of the Cl atoms in O-free gases, and the ratio of the speeds of the reactions $H + HCl = H_2 + Cl$ and $H + Cl_2 = HCl + H$ in flowing gas and at rest. Part III deals with the termination of chains in O-containing gases. The influence of the walls on the termination is discussed. R. N.

THERMODYNAMICS.

2678. The low-temperature properties of gaseous helium. II. R. A. BUCKINGHAM, J. HAMILTON AND H. S. W. MASSEY. *Proc. Roy. Soc. A*, **179**, *pp.* 103–122, *Oct.* 10, 1941.—[See Abstr. 352 (1939)]. Calculations of the second virial and viscosity coefficients of gaseous He have been extended, using as before the exact quantum formulae. A brief discussion of the atomic interaction, which is expressed in the form $V(\sigma) = -\epsilon f(\sigma)$, where $\sigma = r/r_0$, r_0 is the atomic separation when V is a min., and $f(1) = 1$, is followed by the results of the new calculations and their interpretation. Several interactions, with widely varying values of ϵr_0^2, have been employed, and inferences about the actual interaction are made by interpolating the available experimental data. The results of some calculations by de Boer and Michels have been incorporated. The present data for the second virial coefficient, between 2 and 4·3°K., indicate for ϵr_0^2 a value about 122×10^{-16} erg Å^2. Though the separate determination of r_0 and ϵ is not likely to be very precise unless calculations are extended to temperatures much beyond the present limit (11°K.), the assumption of a probable value for the first van der Waals coefficient leads to the values $r_0 = 2{\cdot}93$ Å, $\epsilon = 14{\cdot}2 \times 10^{-16}$ erg. The influence of possible variations in the function $f(\sigma)$ are discussed and shown to be of secondary importance, and these results are based on a reasonable form for $f(\sigma)$ with 2 parameters. Comparisons are also made with 2 viscosity measurements below 5°K., but the inferences from these are not in agreement with the evidence from the equation of state. AUTHORS.

2679. Pressure-volume-temperature relations in solutions. VI. The apparent and partial volumes of sodium bromide dissolved in glycol and the energy/volume coefficients of the solutions at various pressures and temperatures. R. E. GIBSON AND O. H. LOEFFLER. *J. Amer. Chem. Soc.*, **63**, *pp.* 2287–2295, *Sept.*, 1941.—[See Abstr. 1332 (1941)]. The ranges covered are 25° to 105°, 1 to 1 000 bars and zero to 20% NaBr. With the aid of suitable empirical equations first and second derivatives are computed, and hence the thermal expansibilities, the compressibilities, the pressure/temperature and the energy/volume coefficients and $(C_p - C_v)$ for the solutions and the apparent and partial volumes, compressibilities and thermal expansibilities of NaBr in the solutions. The energy/volume coefficients are approx. independent of concentration in the range studied.

The apparent volumes of NaBr in glycol are independent of temperature at const. vol. of the solution, and are compared with the corresponding quantities in aqueous solution. The thermal expansibilities of ethylene glycol, both in the pure state and in solution at different pressures and temperatures, are representable by a single linear function of $1/(B + P)$, a quantity which is obtained directly from the compressibilities of the solutions. AUTHORS.

2680. Phase study of commercial soap and water. J. W. McBAIN. M. J. VOLD AMD J. L. PORTER. *Industr. Engng Chem.*, **33**, *pp.* 1049–1055, *Aug.*, 1941.—The purpose of this investigation is to study the extent to which a typical commercial soap resembles the salts of single fatty acids in phase behaviour. For isotropic liquid, liquid crystalline middle soap, soap boiler's neat soap, superneat soap, and probably also the neat and subneat forms of anhydrous and nearly dry soap, the phase-rule behaviour is qualitatively the same as that of single pure soaps. For other regions of the diagram, however, some fractionation seems to occur. Solubilities of various pure and commercial soaps are each characterized by a value of T_s, the temperature of ready solubility, which can be precisely defined by reference to the lower temperature boundary of moderately concentrated isotropic solution. A palm-oil soap has T_s at 52°C., and above this temperature as much as 30 g. of soap will dissolve in 70 g. water, whereas only 2 deg. below T_s this solubility has fallen to 5 g. in 95 g. water. H. H. Ho.

2681. Thermodynamic study of bivalent metal halides in aqueous solution. II. The activity coefficients of calcium, strontium and barium chlorides at 25° C. A note. J. R. I. HEPBURN AND J. E. GARSIDE. *Trans. Faraday Soc.*, **37**, *pp.* 473–476, *Sept.*, 1941.—[See Abstr. 1874 (1941)].

2682. Thermodynamics of branched-chain paraffins. The heat capacity, heat of fusion and vaporization, and entropy, of 2,3,4-trimethylpentane. K. S. PITZER AND D. W. SCOTT. *J. Amer. Chem. Soc.*, **63**, *pp.* 2419–2422, *Sept.*, 1941.

2683. Thermodynamic properties of the crystalline forms of silica. M. A. MOSESMAN AND K. S. PITZER. *J. Amer. Chem. Soc.*, **63**, *pp.* 2348–2356, *Sept.*, 1941.

2684. The place of "disorder" in the domain of complexity phenomena. A. SMITS. *Z. phys. Chem. B*, **49**, *pp.* 21–26, *May*, 1941. *In German.*—The relations are discussed existing between the notion of disorder-order transformation and that of inner equilibrium. The disorderly states are considered as lying in the boundary range of what the author previously called complexity phenomena. Some of these boundary phenomena may be elucidated only by thermodynamic studies in connection with investigations on Raman spectra and infra-red absorption. R. N.

2685. Construction of thermodynamic models for elementary teaching. J. W. M. DuMOND. *Amer. J. Phys.*, **9**, *pp.* 234–237, *Aug.*, 1941.

See also Abstracts 2455, 2463, 2491, 2498, 2499, 2511, 2655, 2656, 2657, 2659, 2673.

VAPORIZATION AND CONDENSATION.

2686. The vapour-pressure curve. K. FUCHS. *Proc. Roy. Soc. A*, **179**, *pp.* 194–201, *Oct.* 10, 1941.—By an extension of Mayer's theory of condensation, exact equations are derived for the v.p. and the condensation volume of the gas in terms of the virial coefficients on the one hand and the free energy of the condensed phase on the other. The formula for the v.p. reduces in first approx. to Stern's v.p. equation. AUTHOR.

2687. Influence of the difference of molvolumina of liquids on the v.p. curve of their binary mixtures. K. FREDENHAGEN. *Z. phys. Chem. B*, **48**, *pp.* 219–227, *March*, 1941. *In German.*—A reply to Frahm's paper [Abstr. 2463 (1941)], the reply being based on theoretical considerations and on experimental results [Abstr. 822 (1940)]. An influence of the difference of molvolumina is to be expected but it may be obscured by other influences. R. N.

2688. Prevention of fog in cooler-condensers. A. P. COLBURN AND A. G. EDISON. *Industr. Engng Chem.*, **33**, *pp.* 457–458, *April*, 1941.—A theory is developed to explain the occurrence of fog when vapours are condensed in the presence of inert gases. The path of the concentration/temperature curve is most apt to cross the saturation curve with vapours of high mol. wt., which are usually valuable or toxic and must not be lost in the waste gases as a fog. Based on the apparent mechanism of fog formation, a theoretical method of eliminating this undesirable condition is to supply a small amount of heat to the vapour-gas mixture during the condensing process. The method was tested experimentally and found to work on mixtures of air with steam, butyl alcohol and trichlorothylene. AUTHORS.

2689. On the condensation of vapours in a carrier gas. F. FREY. *Z. phys. Chem. B*, **49**, *pp.* 83–101, *May*, 1941. *In German.*—In a modified Wilson chamber the formation of mist by adiabatic expansion is quantitatively observed up to high supersaturations. The number of droplets per unit vol. is determined as a function of supersaturation. In the absence of ions the critical supersaturation is higher and the increase of droplets with supersaturation is smaller. An explanation is given. Lenard's theory of condensation phenomena is discussed. The conditions required for the adiabatic process and the influence of the heat set free during condensation are investigated. R. N.

2690. Vapour-pressure studies. II. Chlorobenzene—1-nitropropane. J. R. Lacher, W. B. Buck and W. H. Parry. *J. Amer. Chem. Soc.*, **63**, *pp.* 2422–2425, *Sept.*, 1941.—The excess free energy of mixing for the system chlorobenzene–1-nitropropane has been measured at 75° and 120°. The heats of mixing of the 3 possible binary systems from ethylene bromide, chlorobenzene and 1-nitropropane, have been determined for approx. equimolar mixtures. The data indicate that the excess entropy of mixing is approx. a linear function of the % vol. change for a considerable variety of liquid mixtures. Authors.

See also Abstracts 2656, 2664, 2679.

ACOUSTICS.

2691. Transverse vibrations of triangular membranes. B. R. Seth. *Proc. Indian Acad. Sci. A*, **12**, *pp.* 487–490, *Nov.*, 1940.—The frequency of an equilateral triangular membrane, derived by Lamé, is independently obtained, and new results are given for an isosceles triangle containing an angle of 120°, and for a right-angled triangle having an angle of 60°. G. E. A.

2692. Investigations on flutes *à bec*. A. von Lüpke. *Akust. Z.*, **5**, *pp.* 39–46, *Jan.*, 1940. *In German.*—By means of sound analysis and octave filter oscillograms [see Abstr. 799 (1936)] the acoustic properties of a flute *à bec* are investigated. The arrangement of the tests is described and illustrated and sound spectra are given for different flutes. The quality of the instruments is shown by curves of wind pressure and acoustic pressure which allow of discerning the purity and balance of sound and the disposition to overblowing. R. N.

2693. Sensitive flames. III. H. Zickendraht. *Helv. Phys. Acta*, **14**, 3, *pp.* 195–214, 1941. *In German.*—After summarizing the known facts regarding the hydrodynamic processes in sensitive flames, the author considers the flames as amplifiers of motion. The motions in long sensitive flames are photographed by means of a stroboscope and a synchronous light siren. The contraction of the flame, which indicates the incidence of the sound, can be explained as the effect of Bjerknes forces, an attractive force between vortex centres and the combustion processes in the flame. An electric method of flame excitation is described which supports the given method of explaining the phenomena. [See Abstr. 5155 (1934)]. G. E. A.

2694. Method for generating extremely strong stationary sound waves in air. H. Oberst. *Akust. Z.*, **5**, *pp.* 27–38, *Jan.*, 1940. *In German.*—A method is described for producing by resonance an acoustic pressure of about 0·1 atm. with purely sinusoidal shape of the pressure/time curve at the antinode formed at the closed end of a thin pipe connected to a pipe of larger diameter. The theory of the system and its experimental examination are discussed and some hints for its application are given. R. N.

2695. Dynamics of the pianoforte string and the hammer. VI. Displacement after impact. VII. Energy of the string. M. Ghosh. *Indian J. Phys.*, **15**, *pp.* 1–14, *Feb.*, 1941.—The expression for the displacement of any point of a finite string excited by impact of a hammer, hard and elastic, is deduced from the general theory [Abstr. 1884 (1941)]. A method for numerical computation is given. The theoretical and experimental values of the fundamental are compared, as well as of the displacement, at different times, when a string of 600 cm. length is struck and observed at distances 120 cm., 290 cm. and 300 cm., from one of the fixed ends.—The theoretical expression for the energy of the finite struck string, for any mass of the hammer, is calculated with the help of the general theory. In the case of a light hammer the pressure terminates before any reflection of the wave from the remoter end overtakes the hammer. So the general expression for energy can be easily reduced to the case of a light hammer, by considering one of the segments of the string to be large. The experimental results of George and Beckett, for light as well as for heavy hammers, are fully interpreted. Two typical cases for heavy hammers, of mass ratio 1 and 3, respectively, have been considered. The theoretical and observed energy loss of the hammers have been graphically compared. The agreement is excellent. Author.

2696. Investigations on sound conduction in water-filled pipes. E. Ganitta. *Akust. Z.*, **5**, *pp.* 87–102, *March*, 1940. *In German.*—The damping and velocity of sound in water-filled pipes depend on physical and geometrical properties of the pipe. Theoretical investigations and measurements on pipes of rubber, glass, brass, Pb, Zn and Fe, were carried out in order to ascertain the dependence of damping on frequency and the influence of the interaction between the pipe walls and the water on the velocity of propagation. The superposition of waves of the same frequency but different wavelengths, in the walls and in the water, may cause anomalies in the acoustic pressure. In order to get reproduceable results the water was made gas-free by boiling. R. N.

2697. Preparation of quartz ultrasonic oscillators. R. R. BAJPAI AND V. I. VAIDHIANATHAN. *Proc. Indian Acad. Sci. A*, **13**, *pp.* 504–509, *June*, 1941.—In certain irrigation problems ultrasonic vibrations are applied, and a technique has been developed to prepare oscillators from the natural hexagonal crystals. The crystal, its geometry and its necessary optical qualities, are described. Blanks are first cut by planes perpendicular to the optical axis. From a blank, slices are cut along planes parallel to the optical axis and parallel to the electric axes which connect 2 opposite edges of the 6-sided prism. The cutting and grinding and the machines for these processes are described. G. E. A.

2698. The synthetic production and control of acoustic phenomena by a magnetic recording system. S. K. WOLF. *Proc. Inst. Radio Engrs, N.Y.*, **29**, *pp.* 365–371, *July*, 1941.—[Abstr. 1814B (1941)].

***2699. Sound analysis with mechanical band filter and high carrier frequency.** G. BUCHMANN. *Akust. Z.*, **5**, *pp.* 7–10, *Jan.*, 1940. *In German.*—The author describes an appliance for automatic sound analysis working with a carrier frequency of 20-40 kc./s. and a mechanical band filter. The latter consists of 2 coupled systems of inert masses and springs, magnetically or electrodynamically excited. The design and working of the appliance is described and some examples of resonance curves drawn by it are shown. R. N.

2700. On sound absorption by resonators. V. L. JORDAN. *Akust. Z.*, **5**, *pp.* 77–87, *March*, 1940. *In German.*—Tests were made with various forms of resonators, consisting of pierced plates of different materials, in front of a rigid wall, the space between plate and wall being empty or filled with a sound-absorbing substance. The resonance frequency was calculated and measured. A simple theory is given, based on an equivalent electric circuit. A number of measured absorption-rate/frequency curves are given as examples. The influence of damping and the various methods of adjustment are discussed. Some practical hints are given for the application of resonators. R. N.

2701. Reverberation time and attenuation constant with grazing incidence. L. CREMER. *Akust. Z.*, **5**, *pp.* 57–76, *March*, 1940. *In German.*—The problem of sound propagation in a 2-dimensional room with 3 rigid and 1 sound-absorbing walls and in a long 2-dimensional duct with 2 opposite sound-absorbing walls is investigated. According to the ratio of wavelength to width of room or duct 2 frequency ranges are dealt with separately. The significance of lateral coupling in the absorbing walls is discussed. The results are similar to those obtained by others. [Abstr. 4651 (1939)]. R. N.

***2702. Demonstration apparatus for Lissajous figures.** P. F. GAEHR. *Amer. J. Phys.*, **9**, *pp.* 94–95, *April*, 1941.

2703. Recording of small variations in pitch. M. GRÜTZMACHER AND W. LOTTERMOSER. *Akust. Z.*, **5**, *pp.* 1–6, *Jan.*, 1940. *In German*—By means of a novel measuring outfit the original sound curve is transformed into voltage tips following each other with the period of the fundamental of the voltage curve. These voltage tips control 2 relaxation valves acting on the beam of a cathode-ray tube which records the pitch. Examples are given showing the curves of gramophone and sound film sounds, instrumental and vocal tones and the standard pitch as used in broadcasting. Within an intensity range of 40 db the deviations from the nominal value of frequency are below 1 ‰. R. N.

2704. On the equivalent diagram of the spherical detonation. L. CREMER. *Akust. Z.*, **5**, *pp.* 46–50, *Jan.*, 1940. *In German.*—The acoustical equivalent diagram is compared with an electrical equivalent circuit consisting of inductance and resistance in parallel switched on to a charged capacitor. The results of the investigations are compared with those of the theories of Rayleigh and Lamb. R. N.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

2705. Transient similarity and equivalence in *n*-mesh linear networks. M. D. COOPER AND R. S. BURINGTON. *Phil. Mag.*, **32**, *pp.* 302–314, *Oct.*, 1941.—Two linear networks (N_1,N_2) of n meshes having network matrices A_1 and A_2 respectively, each of order n, are said to be transiently similar if their matrices A_1 and A_2 have the same Segre characteristic. The networks N_1 and N_2 are said to be transiently equivalent if their matrices are equivalent. If N_1 and N_2 are transiently equivalent it is shown that they are also transiently similar, but the converse is not true. N_1 and N_2 are transiently equivalent if, and only if, the Smith normal forms of A_1 and A_2 are identical. Two transiently equivalent networks have the same invariant factors, the same elementary divisors, and the same Segre characteristic. A complete classification is given of the set of all n-mesh networks with respect to transient behaviour. The case of $n = 2$ is considered in detail and gives a complete and improved solution of the classification of oscillatory phenomena in coupled circuits undertaken by Quade. The connections between steady-state equivalence, transient similarity and transient equivalence, are considered in detail.

A. W.

CONDUCTION AND DISCHARGE IN GASES.

2706. Partition functions, degrees of dissociation and of ionization of gases. K. H. RIEWE. *Z. phys. Chem. A*, 184, 6, *pp.* 393–398, 1939. *In German.*—The partition functions for atoms and molecules are composed of an outer translational and an inner part, the latter comprising a rotational, a vibrational, an electron term and a nuclear-spin part. By means of a permutation principle and Stirling's formula the formulae are derived for the partition functions of partly dissociated and ionized gases and for the degrees of dissociation and ionization as derivable from the former. A short survey is given of the various applications of these formulae, e.g. with relation to heat conductivity, sp. hts. and dissociation in electrolytes.

R. N.

2707. The localization of the discharge in ordinary and canal-ray tubes. V. T. CHIPLONKAR. *Proc. Indian Acad. Sci. A*, **12**, *pp.* 440–452, *Nov.*, 1940.—The distribution of the current on the cathode surface of a discharge tube is investigated by the use of a cathode divided into rings, each ring being insulated from its neighbour and connected separately to earth through a sensitive milliammeter. There is found to be in general a concentration of current in the centre which increases with voltage, but for a given gas the extent of this concentration is determined by the length of the cathode dark space and, if this can be kept constant, is independent of voltage. The localization increases with the length of the cathode dark space up to a stationary value. Under conditions of canal-ray discharge the effects are much the same. J. T.

2708. Fluctuations in space-charge-limited currents at moderately high frequencies. I. General survey. B. J. THOMPSON. **II. Diodes and negative-grid triodes.** D. O. NORTH. **III. Multi-collectors.** D. O. NORTH. **IV. Fluctuations caused by collision ionization.** B. J. THOMPSON AND D. O. NORTH. **V. Fluctuations in vacuum tube amplifiers and input systems.** W. A. HARRIS. *RCA Rev.* [*Radio Corp. Amer.*], **4**, *pp.* 269–285, *Jan.*; 441–472, *April*; **5**, *pp.* 106–124, *July*; 244–260, *Oct.*, 1940; *pp.* 371–388, *Jan.*; 505–524, *April*, and **6**, *pp.* 114–124, *July*, 1941.—[Abstr. 1803B (1941)].

2709. Effects of h.v. discharge on thermal decomposition of ethane. I. H. PARRILL AND W. G. EVERSOLE. *Industr. Engng Chem.*, **33**, *pp.* 1316–1317, *Oct.*, 1941.—Ethane is decomposed to ethylene and hydrogen in the glow discharges. Methane production becomes greater at higher temperatures and higher energy input. Decomposition of ethane occurs in the glow discharge, yielding decomposition products corresponding to those obtained by thermal action at 300°C. higher temperature. Decomposition proceeds at temperatures as low as 100°C. AUTHORS.

CONDUCTION IN SOLIDS AND LIQUIDS.

2710. Electrical resistance and thermo-electric power of the transition metals. H. H. POTTER. *Proc. Phys. Soc., Lond.*, **53**, *pp.* 695–705, *Nov.*, 1941.—The resistances and thermo-electric powers of the transition metals and their variations with temperature have been measured. The relation of the results to the theory of Mott and Jones is discussed. AUTHOR.

2711. Titration and conductivity measurements of aqueous extracts from bottles. E. H. HAMILTON AND D. HUBBARD. *Bur. Stand. J. Res., Wash.*, **27**, *pp.* 381–394, *Oct.*, 1941.—In a study of the titration of aqueous extracts from glass containers it was shown that certain precautions must be observed if reliable results are to be obtained. Direct and back titrations were made potentiometrically and with a series of indicators to demonstrate the effect of the presence of CO_2 and of flakes. When the alkalinities of the aqueous extracts from bottles, as determined by direct titration, were plotted against their sp. conductivities, a linear relation was obtained for 9 out of 13 different bottles. The "back titers" of the filtered extracts, when plotted against the conductivities, gave a similar straight line for the same 9 bottles. The relation between the "back titers" and the conductivities of unfiltered extracts was variable. The results indicate that the determination of only one property of the extracts, such as alkalinity or conductivity, may lead to erroneous conclusions.

AUTHORS.

2712. Electric conductivity of U oxides. K. HAUFFE. *Z. phys. Chem. B*, **48**, *pp.* 124–130, *Jan.*, 1941. *In German.*—With regard to the theory of mixed phases with defective arrangements [Abstr. 1716 (1931)] the electric conductivity of UO_2 and U_3O_8 in the temperature range 800°–1 000°C. was determined at varying pressures of O. In the pressure ranges measured the conductivity was found to be independent of O pressure in both cases. The energy increment ΔE in the formula for the temperature function of conductivity $\kappa =$ const. $e^{-\Delta E/RT}$ was found to be 5 k.cal. for the U_3O_8 phase between 700° and 900°C. R. N.

DIELECTRICS AND CAPACITANCE.

2713. Electrical properties of solids. IX. Dependence of dispersion on molecular weight in the system polyvinyl chloride-diphenyl. X. The system polyvinyl chloride tetrahydronaphthalene. R. M. Fuoss. *J. Amer. Chem. Soc.*, **63**, *pp.* 2401–2413, *Sept.*, 1941.—[See Abstr. 1065 (1941)]. The fractionation of polyvinyl chloride is described. Electrical data over the frequency range 60–10 000 c./s. at a number of temperatures are reported for different fractions of polyvinyl chloride, plasticized with 20% diphenyl. Data are also given for a number of unfractionated polymers of different average mol. wt. A range of about 5 : 1 in mol. wt. was covered. The most probable relaxation time of a polar polymer, as measured by the reciprocal of the frequency of max. absorption at a given temperature, is proportional to the degree of polymerization. The dipole moment per monomer unit in a linear polymer of the type $(-CH_2CHX-)_n$ is independent of the degree of polymerization.—Absorption and dispersion measurements in the range 60 c./s. to 10 kc./s. are reported for the system polyvinyl-chloride-tetrahydronaphthalene at temperatures which bring the max. absorption into the frequency range given. Plastics containing up to 40% hydrocarbon by wt. are covered. The mean moment per (CH_2CHCl) group is shown to approach 1·73 *D* with increasing dilution, which is the theoretical limit for a linear polar polymer of alternating structure, assuming free rotation. Positive deviations at high concentrations of polymer or low temperatures are explained qualitatively as an increase of average moment due to configurations in which the chain molecules are not in their most probable state. Author.

2714. Measurements of dipole moments of free radicals. G. Karagunis and T. Jannakopoulos. *Z. phys. Chem. B*, **47**, *pp.* 343–356, *Nov.*, 1940. *In German.*—Free radicals are shown to have no dipole moment. Their mesomeric properties are discussed. The measurements for determining the dipole moments of free radicals in solution are based on the temperature dependence of molecular polarization. The apparatus used is described and illustrated. Some deductions are drawn on the stereochemical behaviour of trivalent *N* based on analogy considerations. R. N.

2715. Refractive index of PF_5 and OsO_4 and dielectric constant of OsO_4, SF_6, SeF_6 and TeF_6. R. Linke. *Z. phys. Chem. B*, **48**, *pp.* 193–196, *March*, 1941. *In German.*—The results of the author's measurements and those of previous investigators are used for establishing relations concerning the ratio of atomic and electronic polarization. For series of compounds with analogous structure this ratio is a relative measure of the polarity of linkage. R. N.

2716. On the dielectric constants of ionized gases at medium r.f. S. R. Khastgir and C. Choudhury. *Indian J. Phys.*, **15**, *pp.* 63–71, *Feb.*, 1941.—Measurements of the effective dielectric constants of ionized air and He in the discharge tubes by the double-beat method yielded the following results for medium frequencies (1 100 kc./sec. to 375 kc./sec.): When the frequency of the measuring field was fixed, the eff. dielectric const. which was found slightly greater than 1 increased proportionately with the increase of the discharge current except when the latter was large. When the discharge current was fixed, the eff. dielectric const. decreased gradually with the increase of the wavelength of the measuring field. The possibility of a resonance frequency of the ionized medium much higher than the frequency employed has been indicated. Accepting such a resonance frequency it would be possible to explain both sets of results according to the classical dispersion formula. Authors.

See also Abstract 2602.

ELECTROCHEMISTRY.

2717. Electrical charges and potentials in cells resulting from metabolism of electrolytes. R. R. Williamson. *Bull. Math. Biophys.*, **3**, *pp.* 79–87, *Sept.*, 1941.—An approx. solution for the relation of the charges and potentials in a spherical cell to the production of electrolytes in the cell and their diffusion resistances is derived. The potential obtained by introducing reasonable values of the constants is of the proper order of magnitude. The equations are applied to a respiratory chain, and the relation between oxygen consumption, glycolytic coefficient, and potentials, is determined. Available experimental data are compared with the theory. Author.

2718. Studies in electrode polarization. III. Note on the theoretical implications of the rate of growth of polarization potentials. A. Hickling. *Trans. Faraday Soc.*, **37**, *pp.* 532–535, *Oct.*, 1941.—The rate of growth of a polarization potential due to the accumulation of an active product on the electrode surface is considered, and it is shown that a linear dependence of potential upon quantity of electricity passed is to be expected in many cases. The application of this result to the case of hydrogen overvoltage is stressed, and it is shown that the experimental results are in no way contrary to the atomic hydrogen theory. [See Abstr. 535 (1940)]. AUTHOR.

2719. Importance and measurement of hydrogen ion concentration. N. G. NEUWEILER. *Schweiz. Bauztg*, **118,** *pp.* 37–41, *July* 26, 1941. *In German.*—This paper contains a review of the whole subject of H-ion concentration, and deals at some length with buffer solutions and the importance of *p*H control for various industrial processes, details of which are tabulated. The various methods for *p*H determination are then discussed, including the colorimetric, electrometric, and various electrode processes such as use of the hydrogen, quinhydrone, antimony, and glass electrodes. The paper contains valuable details illustrated by diagrams and tables. H. H. HO.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

2720. Theoretical and experimental investigations of electron emitters. J. DOSSE. *Z. Phys.*, **115,** 9–10, *pp.* 530–556, 1940. *In German.*—The important properties of electron emitters are correlated with the geometrical and electrical quantities of the cathodes. O. O.

2721. The scattering of neutrons by deuterons and the nature of nuclear forces. R. A. BUCKINGHAM AND H. S. W. MASSEY. *Proc. Roy. Soc. A*, **179,** *pp.* 123–151, *Oct.* 10, 1941.—The theory of the scattering of neutrons by deuterons has been worked out for neutrons with energy in the range 0–11·5 eMV. It is assumed that the interaction energy of all fundamental particles is the same, and calculations have been carried out assuming 3 types of such interaction—an ordinary unsaturated force, an exchange force of Majorana-Heisenberg type, and a "mixed" exchange force involving all exchange operators. The space-dependent part of the interaction is taken to be of the form $Ae^{-2r/a}$, with the constants A and a as determined by Present and Rarita from a study of the binding energies and collision properties of the light nuclei. To obtain differential equations for the functions describing the relative motion of neutron and deuteron, Wheeler's method of resonating group structure was employed. The resulting integro-differential equations, which include exchange of particles as well as exchange forces, were solved numerically. An exact solution of the deuteron internal wave equation for the exponential interaction was used throughout. Results for the total elastic cross-section, calculated with exchange forces, agree well with the observed values, but ordinary forces give, for 2·2 eMV neutrons, a cross-section 1·5 times too large. The calculated angular distribution, in relative co-ordinates, is very much more uniform for exchange forces than for ordinary forces. For 2·2 eMV neutrons this difference is so marked as to be easily detectable by experiment, and it is deduced that the measurements by Barschall and Kanner of the angular distribution for such neutrons are compatible only with the assumption of exchange forces. It is pointed out that the result that ordinary forces lead to a much less uniform angular distribution is likely to be a general one, independent of the detailed accuracy of the theory. AUTHORS.

2722. On the deceleration of high-energy protons and neutrons by emanation of mesotrons. F. S. WANG. *Z. Phys.*, **115,** 7–8, *pp.* 431–455, 1940. *In German.*—The effective cross-sections are computed for the process in which a proton or neutron, the energy, E_p, of which is large compared with its rest energy M, emits a mesotron when colliding with a nucleus. If the radiation of a heavy particle is caused by the Coulomb force of the nucleus, the effective cross-section is larger by the factor E_p/M than for the case of a nuclear exchange force. The reason for this small effect in the latter case comes from the scalar Yukawa theory. For the Coulomb force a nearly monochromatic spectrum is obtained for the energy of the mesotron. Contrary to the radiation of light quanta the total effective cross-section does not contain the mass of the impinging particle but the mass of the mesotron in the denominator. The reason is that the Yukawa field around a heavy particle has a charge which can be moved independently of the mass of the particle. Above 10^{11} eV the energy loss of a heavy particle caused by emanation of mesotrons exceeds the energy loss by ionization in water or air. Consequently, the heavy particles should have a very high penetrating power in the energy range between 10^9 and 10^{11} eV. O. O.

2723. The individual scattering of fast electrons in aluminium and nickel. W. BOTHE AND L. RATZEL. *Z. Phys.*, **115,** *pp.* 497–513, 1940. *In German.*—With the help of the magnetic electron lens homogeneous electron bands are produced up to 2·4 eMV. The individual scattering is investigated in Al and Ni foils. O. O.

2724. On the relative cross-sections of the (*n*, *a*) and (*n*, *p*) reactions produced by fast neutrons. T. AMAKI AND A. SUGIMOTO. *Sci. Pap. Inst. Phys. and Chem. Res., Tokyo, No.* 103', *pp.* 377–381, *June,* 1941.—Using the induced radioactivities, the relative cross-sections of the (*n*, *a*) and (*n*, *p*) reactions caused by fast neutrons were studied for some elements lighter than Zn. AUTHORS.

2725. The magnetic electron lens. A. L. HUGHES. *Amer. J. Phys.*, **9,** *pp.* 204–207, *Aug.*, 1941.

2726. Contribution to the theory of the electric deflection of electron beams. I. General investigations on the path of the rays in electrostatic deflecting fields. II. Electric deflection of an (enlarged) electron optical picture and resulting picture and deflection faults to the 3rd order. III. Dynamic picture construction by crossed electric deflecting systems and resulting picture faults to the 3rd order. J. Picht and J. Himpan. *Ann. Phys., Lpz.*, **39**, 6–7, *pp.* 409–501, 1941. *In German.*—A theory of the deflection of electron beams by electrostatic prisms is established on a broad basis without taking account of possible simplifications for definite practical applications. The asymmetric electric field is represented by a potential series, in which, however, the coefficients which occur can be readily determined by measurement and graphically. The ideal deflection and the deflection to the 3rd order are discussed.—The basic formulae derived in the first paper are applied to the deflection of an enlarged electron optical picture. The picture and the deflection faults which occur are comprehensively discussed in their effect on the deflected picture, and are graphically illustrated. The picture defects are subdivided into distortional and aperture faults of the 1st order, distortional aperture and formation faults of the 2nd order, and formation faults, astigmatism and aberration, coma faults and aperture faults of the 3rd order.—The ideal dynamic picture construction by two crossed deflecting systems of variable voltage (important in television) is discussed. The picture faults due to the 1st deflecting prism are derived using certain of the results of the second paper. They are of the 3rd order only. Those arising from the 2nd deflecting system are also determined. The effect of the faults of the two systems on one another is investigated, and the influence of the resulting faults on the quality of the picture is discussed and graphically illustrated. Account is taken of the magnitude relations between the coefficients characterizing the individual faults, as well as of the only possible signs of the coefficients under certain conditions. H. G. S.

2727. Bond energies and repulsion energies in proton-transfer reactions. R. P. Bell. *Trans. Faraday Soc.*, **37**, *pp.* 493–496, *Oct.*, 1941.—In a proton-transfer reaction of the type $BC + A \rightarrow B + CA$, where C represents a proton, the only important contribution to the interaction energy E_t will be the interaction between A and B. It has previously been assumed that the energy of repulsion does not contribute to the activation energy, but that the centres A and B approach to a certain fixed distance during the reaction without the expenditure of energy. In the present paper this crude assumption is replaced by an approx. calculation of the part played by the interaction energy between A and B. The case considered is the transfer of a proton between 2 identical centres, taken to be C atoms, and the problem is treated by means of intersecting energy curves. Results indicate that previous treatments based purely on considerations of bond energies are substantially correct. N. M. B.

2728. Sex-linked mutations of *drosophila melanogaster* induced by neutron radiations from a cyclotron. II. Y. Nishina and D. Moriwaki. *Sci. Pap. Inst. Phys. and Chem. Res., Tokyo, No.* 1030, *pp.* 371–376, *June*, 1941.

See also Abstracts 2448, 2450, 2659.

MAGNETISM AND ELECTROMAGNETISM.

2729. The electron theory of crystalline compounds of the type of copper oxide. H. Dressnandt. *Z. Phys.*, **115**, 7–8, *pp.* 369–409, 1940. *In German.*—By the study of the bivalent compounds of Cu the behaviour of electrons in ionic crystals is elucidated, in particular the limitations of the present theory. In order to explain the magnetic behaviour the author gives a theory of antiferromagnetic order of the spins in the crystal grating. In this theory the exchange interaction is important. In the electron theory of metals and in Wilson's semi-conductor theory a periodic potential is assumed in order to explain that, even in the normal state, the electrons are grouped in energy bands. In the present theory it is proved that in most ionic gratings this assumption is not justified. The reason is that the electrons do not move as easily as in metals. A 1-dimensional model of a potential curve leads to bound electrons which can be changed to conducting electrons only by a finite amount of energy. In particular in CuO this energy of internal ionization is estimated. Finally, this mechanism is compared with other possible mechanisms. O. O.

2730. Calculation of diamagnetic anisotropy of aromatic molecules from the density distribution of B-electrons as furnished by the box model. O. Schmidt. *Z. phys. Chem. B*, **47**, *pp.* 1–47, *Aug.*, 1940. *In German.*—B-electrons are defined as valency electrons, not disposable in simple linkages and responsible for the diamagnetic anisotropy. Rayleigh's box model and the Schrödinger equation are used for calculating the radial distribution of B-electrons and their mean radius. At the edges of the box the density distribution is calculated from the theory of metals. This is justified by the fact that graphite forms the elementary link in aromatic chemistry and may be considered as a metal, considering the relations of its resistivity with temperature. There is a good agreement between the values for the mean radii calculated according to this theory and those found by previous investigators [Abstr. 1830 (1937)] for dual groups of peripheric B-electrons. An analogy exists with electrons causing supraconductivity. R. N.

2731. Magnetic measurements on semiquinone radicals in the dissolved state. L. Michaelis. *J. Amer. Chem. Soc.*, **63,** *pp.* 2446–2451, *Sept.*, 1941.—A differential magnetometric method is described by which the development of a semiquinone radical on partial reduction of organic dyestuffs can be recognized owing to the increment of susceptibility caused by the free radical. In some cases the difference in susceptibility is measured before and after adding the reducing agent (ascorbic acid), namely in strongly acid solution of thiazine dyestuffs. In other cases the method of slow reduction is used, for example in alkaline solution of oxonine, where glucose is added at the beginning, and the change of susceptibility is measured during the slowly progressing reduction. In the case of oxonine the paramagnetic increment passes through a max. The max. conc. of the free radical, calculated from the magnetic data, agree with those values previously obtained by the potentiometric method. In addition the data show that, for the dyestuffs examined, no noticeable dimerization of the radicals takes place although the concentrations of the dyes are more than 100 times higher than in the potentiometric experiments formerly described. Author.

2732. Magnetic measurements on trimethyltin and tricyclohexyllead. H. Morris and P. W. Selwood. *J. Amer. Chem. Soc.*, **63,** *pp.* 2509–2510, *Sept.*, 1941.—[See Abstr. 259 (1940)].

See also Abstract 2449.

MEDICAL RADIOLOGY AND ELECTROLOGY.

***2733. The construction of a universal dosemeter with notes on its use for the measurement of high resistances.** F. Happey. *Brit. J. Radiol.*, **14,** *pp.* 336–340, *Oct.*, 1941.—Details of construction of an ionization chamber dosemeter are given, as regards the general arrangement, the construction of the ionization chamber (where a British substitute has been found for a German wall material "Aerion"), the circuits of the instrument employing a "Townsend balance," the vacuum system and the condenser employed. A Lindemann electrometer is used. B. J. L.

2734. Irradiation chamber for therapeutic research. M. Luckiesh and A. H. Taylor. *Gen. Elect. Rev.*, **44,** *pp.* 426–428, *Aug.*, 1941.—Describes an ultra-violet light bath of parabolic form into which the patient is wheeled upon a stretcher. The bath is illustrated and shown schematically, and a description is given of 6 mercury vapour lamps incorporated in the bath. These lamps are continuously cooled by flowing water which removes the heat radiation and, whilst some ultra-violet light is also absorbed, the emission of ultra-violet energy is 10 600 μW/cm.^{2} when filters are omitted (sunlight: 2 500 μW/cm.^{2}); a min. perceptible erythema is reached in 1·5 min. (sunlight: 15–20 min.). Flexible control of the emission spectrum is obtained by filtration, particulars being given. B. J. L.

2735. Electrosurgery. A. W. Lay. *Wireless World*, **47,** *pp.* 231–233, *Sept., and pp.* 256–257, *Oct.*, 1941.—A general non-technical account of the use of h.f. currents in the range 1–5 Mc./s. (60–300 m.) in major surgical operations. Harmful effects are nullified by virtue of the rapid reversal of the polarization of the electric field which would otherwise cause electrolytic decomposition of the body fluids. A spark generator provides the current, and electrosection and cauterization of the tissue are carried out simultaneously by specially shaped electrodes (wire, loop, or blunt blade). These do not cut the tissue mechanically. The cutting effect depends on the intense concentration of heat in a minute arc at a point of the operating electrode during the cutting stroke. The electrode must move continuously to avoid charring and to produce a white film of clotting on each side of the cut. Other operations described are destruction of diseased tissue by drying up by intense local concentration of heat, electrodesiccation of wounds or surface abnormalities by a train of h.f. sparks, and correction of detachment of the retina by removal of fluid. For ophthalmic and brain surgery a valve generator is described. N. M. B.

OSCILLATIONS AND WAVES.

2736. Non-linear distortion, with particular reference to the theory of frequency-modulated waves. I. E. C. Cherry and R. S. Rivlin. *Phil. Mag.*, **32,** *pp.* 265–281, *Oct.*, 1941.—[Abstr. 1799 B (1941)].

PIEZO-ELECTRICITY.

See Abstracts 2452, 2643.

THERMIONICS.

2737. Positive and negative thermionic emission from molybdenum. R. W. Wright. *Phys. Rev.*, **60,** *pp.* 465–467, *Sept.* 15, 1941.—The positive and negative thermionic emission from Mo has been studied. The electron work function was found to be 4·20 V and the positive ion work function was 8·6 V. Author.